Midtown Oakville

Transportation and Stormwater

Municipal Class

Environmental [illegible]

Final Report

[illegible]

[illegible]

Report and Appendices [illegible]

Create it! Vision 2057

OAKVILLE

Executive Summary

A. Introduction and Background

The Midtown Oakville Municipal Class Environmental Assessment (EA) study develops a practical, long-term strategy to guide the development of the transportation and municipal stormwater network needed to accommodate the planned growth in Midtown Oakville to 2031, as identified in the Livable Oakville Plan, the town's official plan.

This project is a continuation of Switching Gears, Oakville's Transportation Master Plan study, to further assess the infrastructure needs in Midtown Oakville to meet Phase 3 and 4 of the Class EA planning and design process, as outlined in the Municipal Engineers Association "Municipal Class Environmental Assessment", (October 2000, as amended in 2007 and 2011).

Cole Engineering Group Ltd. was retained by the Town of Oakville in 2012, following completion of the town's Transportation Master Plan study to complete this Municipal Class EA study for Midtown Oakville.

Study Objectives

Midtown Oakville is a designated urban growth centre in the province's *Places to Grow* growth plan and a mobility hub within the Metrolinx regional transportation plan *The Big Move*. Midtown Oakville is envisioned to be a vibrant, transit-supportive, mixed-use urban community, as identified in the Livable Oakville Plan. Improvements to the existing network to enhance growth and economic development opportunities, as well as stormwater system improvements to support the proposed transportation network, will help ensure that Midtown Oakville has a balanced, accessible and sustainable transportation network for all modes of travel (walking, cycling, transit and vehicles). When completed, the preferred solution will be implemented through an amendment to the Livable Oakville Plan.

Study Area and Location

Midtown Oakville is centred on Trafalgar Road and the QEW as shown in **Figure ES-1**. Midtown Oakville is characterized by several unique and highly desirable features, including a large wooded ravine, natural heritage, and large-scale public land ownership. It is approximately 100 hectares in size and bounded by the Queen Elizabeth Way (QEW) to the north, Cornwall Road to the south, Chartwell Road to the east, and Sixteen Mile Creek valley to the west. For purposes of this Municipal Class EA, the study area also encompasses areas to the north and east of the urban growth centre limits.

Figure ES-1: Study Area

B. Consultation

Consultation with the public and technical agencies was a key component of the EA process. For this study, an intensive consultation program was followed. The study team met with various stakeholders and technical agencies throughout the duration of the study to gather valuable input and varying opinions. The following sections briefly present the consultation program.

Technical Agencies Committee

The Technical Agencies Committee (TAC) was formed at the project initiation stage. A long list of agencies were invited to the TAC meetings.

The first TAC meeting was held on July 17, 2012 to present various elements of the study, including transportation needs, future traffic volumes, road concept screening options and alternatives, stormwater management design, and constraints such as utility conflicts and property impacts. The second TAC meeting was held on March 27, 2014 to present a study update, details of the preferred concept and next steps.

Comments received from Conservation Halton (CH) required additional consultation with CH staff. A number of additional meetings and conference calls were held with respect to issues regarding stormwater, a candidate significant woodlot and crossing of the Morrison Creek diversion channel.

The Ministry of Transportation (MTO) expressed concerns regarding the new connections to QEW and impacts to mainline traffic flows. A series of meetings were held with MTO as a microsimulation model

was developed and calibrated to demonstrate future operations on QEW with and without the proposed Midtown Oakville improvements. Modifications were adopted into the resulting design to address weaving and merging on the QEW.

Additional consultation with Metrolinx and Halton Region occurred over the course of the study to share information regarding parallel studies, integrate proposed plans and property requirements.

Agency Stakeholders Workshop

A two-day Agency Stakeholders Workshop was held in March 2013. The workshop was split into two all-day sessions to provide sufficient time to accommodate the volume of material to be reviewed as well as a working session to develop network alternatives. The first session was held on March 1, 2013, and the second session was held one week later, on March 8, 2013.

The workshop was held in order to collaborate with key players from various agencies that contribute to the overall development of Midtown Oakville. The meeting built upon decisions and work completed to date, and allowed participants to work in groups in a design charrette format to layer pedestrian, cycling, transit, and road improvements onto aerial maps to determine preferred solutions. Advantages and disadvantages of various improvements were discussed, and the evaluation criteria assessing the improvements were also presented.

Stakeholders

A Stakeholder Advisory Group comprising of representatives from various associations was formed at the project initiation stage.

The first Stakeholders Advisory Group meeting was held on July 17, 2012. This meeting was held in order to present various elements of the study, including transportation needs, future traffic volumes, road concept screening options and alternatives, stormwater management design, and constraints, such as utility conflicts and property impacts.

The second Stakeholders Advisory Group meeting was held on March 27, 2014 to present a study update, details of the preferred concept and next steps.

Public

Three Public Open House (POH) sessions were held over the course of the study.

The first POH was held at town hall on June 13, 2012. This POH was the first point of contact with the general public to present an overview of existing conditions, conceptual plans for the future, and to request input on issues, concerns and suggestions for consideration during the study. A panel discussion led by members of the study team actively involved the public in discussion. Information was also provided on display boards in an informal open house format to solicit feedback from attendees and to offer the opportunity to interact with the study team.

The second POH was held at town hall on June 19, 2013. The purpose of the second POH was to present the study background and context, the road, active transportation and transit needs, the main priorities and evaluation criteria, the alternative improvements, the preliminary evaluation, and to gather public input. Attendees were encouraged to ask questions and/or provide feedback following a formal presentation. An information package was distributed as attendees moved to seven roving stations that highlighted the various alternatives and preliminary evaluations and were facilitated by study team members.

The third POH was held at town hall on April 2, 2014. The purpose of this POH was to review the project details, present the preferred solution to the public, and address public comments. Attendees were provided with an information package that contained background information and details about the elements of the preferred plan. Display boards were available for review prior to and following a formal presentation. There was also a private landowners room available with town staff to address any individual questions and concerns of impacted property owners.

Impacted Landowners

A series of meetings were held in March 2014 with the impacted landowners. The meetings allowed landowners to discuss individually with town staff any concerns regarding the property requirements for the proposed transportation improvements in Midtown Oakville.

C. Needs and Opportunities

The Midtown Oakville growth area is envisioned for a minimum gross density of 200 residents and jobs (combined) per hectare by 2031 in accordance with the Province's Growth Plan. A mix of approximately 5,900 residential units and 186,000 to 279,000 m^2 of commercial and employment space is expected to accommodate an estimated 12,000 residents and 8,000 jobs. The needs and opportunities for accommodating the planned growth were investigated.

Existing Transportation Conditions

Currently the road network for Midtown Oakville is made up of one key north-south arterial – Trafalgar Road crossing the QEW. A supporting network of arterial and local roads provide access to existing land uses. The Oakville GO station is a major transit hub within Midtown Oakville and is well served by transit – 16 Oakville Transit routes connect to GO Rail and GO Bus routes.

There is limited existing pedestrian and cycling infrastructure. Sidewalks are provided on only some roads, multi-use trails are provided in the boulevards along Leighland Avenue and Eighth Line, and on-road cycle lanes are provided on White Oaks Boulevard. Along the western edge of Midtown Oakville is the Sixteen Mile Creek Trail and to the northeast is the Morrison Valley Trail.

Intersection capacity analysis was undertaken for the existing traffic conditions. Through discussions with the Ministry of Transportation (MTO), a VISSIM microsimulation model was also developed to assess the operations of the QEW mainline and ramp terminals at the interchanges that provide access to Midtown Oakville – Trafalgar Road and Royal Windsor Drive.

The observed traffic in the Midtown Oakville area indicates capacity constraints and congesting at peak times. Although most signalized intersections within the study area operate at acceptable levels of service, two intersections – Cross Avenue / Lyons Lane and Cross Avenue/Cornwall Road – experience more significant capacity constraints under existing conditions. These congestion issues also impact Oakville Transit service to and from GO Oakville station.

On the QEW, operational constraints were identified in AM peak for eastbound traffic around the Dorval Drive interchange and westbound at the Royal Windsor Drive interchange. In the PM peak a westbound constraint occurs between Ford Drive and Trafalgar Road interchanges due to high volumes and weaving manoeuvers.

Future "Do Nothing" Transportation Conditions

An assessment of the transportation network within the study area without any new Midtown-related transportation infrastructure improvements was undertaken to identify the operational performance of the "Do Nothing" network in accommodating Midtown Oakville growth.

Although the "Do Nothing" scenario assumes no improvements to the transportation infrastructure within Midtown Oakville, it does include a number of planned and committed transportation improvements by region and town as per the 2031 Base Case in the town's TMP. Additionally, through consultation with MTO, planned provincial improvements documented in MTO's *Transportation Environmental Study Report for Highway 403 and Queen Elizabeth Way from Trafalgar Road to Winston Churchill Boulevard* (TESR) are explicitly modelled in the "Do Nothing" scenario. These include:

- Extension of the existing HOV lanes on QEW from Trafalgar Road to Winston Churchill Boulevard
- North to East (Highway 403 SB to QEW EB) and East to North (QEW WB to Highway 403 NB) ramps at the Highway 403 / Ford Drive interchange
- Core-collector system along QEW to facilitate movements between Ford Drive and Winston Churchill Boulevard and to accommodate the new North to East / East to North ramps

Overall, during the AM and PM peak hour, most signalized intersections within the study area will operate with significant capacity constraints. The existing municipal road network does not have enough reserve capacity to accommodate full build-out of Midtown Oakville. Transit service on Trafalgar Road and Cross Avenue will be significantly impacted by traffic delays on the road network.

Using the microsimulation model, the QEW was found to have significant operational constraints at the Trafalgar Road interchange in both the AM and PM peaks, with the interchange ramp terminals being unable to serve the demand placed and queues spilling back onto the QEW mainline. The operational constraint eastbound at Dorval Drive interchange on the QEW is exacerbated by future traffic growth.

Existing Drainage Conditions

Major drainage areas within the Midtown Oakville study area were determined using 1 m contour data provided by the town. The drainage areas were further refined based on plan and profile information received from the town for roads and highways within the study area. The drainage catchments within the Midtown Oakville study area contribute flow to the following four watercourses:

- Lower Morrison Creek
- Wedgewood Creek
- Morrison/Wedgewood Diversion Channel
- Sixteen Mile Creek

The existing drainage conditions of the Midtown Oakville study area were simulated using a Visual OTTHYMO (VO2) hydrology model. The hydrologic parameters were determined for each drainage catchment within the Midtown Oakville study area, including the assessment of current imperviousness determined based on the land use of each catchment. Target flows for each of the four subwatersheds were determined based on the existing flow conditions.

As per the *Lower Morrison/Wedgewood Creeks – Flood, Erosion and Master Drainage Plan Study (R.V. Anderson, 1993)*, there are downstream hydraulic capacity constraints which must be considered when establishing allowable discharge rates from all new developments within the Lower Morrison Creek and Wedgewood Creek subwatersheds. Using updated hydrologic modelling and the assessments completed in the R.V. Anderson report, target peak flow rates were determined for each of the four watersheds.

It is also indicated in the *Morrison/Wedgewood Diversion Channel – Spill Control Class Environmental Assessment*, prepared by AMEC Environment & Infrastructure (May 2012), that there is a current potential for a spill of flood waters during extreme storm conditions which potentially affect those lands within the vicinity of the diversion channel, as well as properties further downstream. However, work is currently being undertaken on behalf of Conservation Halton in order to mitigate these flood impacts of the diversion channel.

D. Problem and Opportunity Statement

The following problem / opportunity statement was developed for the Midtown Oakville Municipal Class EA study by considering existing conditions and input from the project team, technical agencies, and various stakeholders:

> *Midtown Oakville is a provincially designated Urban Growth Centre and there is an opportunity for this area to develop into a "complete urban community", as identified in Livable Oakville. For Midtown Oakville to achieve these policy objectives, there is a need to improve the existing transportation network to enhance growth and economic development opportunities. Stormwater system improvements to support the proposed transportation network may also be required to help ensure Midtown Oakville has a balanced, accessible and sustainable transportation network for all modes of travel (walking, cycling, transit service and vehicles).*

E. Alternative Network Solutions

Given the needs for the Midtown Oakville area, a number of opportunities to accommodate pedestrians, cyclists, transit riders and vehicles, such as improving connections, enhancing the public realm, and establishing a mix of uses, have been identified. Potential infrastructure improvements range from revised road alignments to new road, transit, and active transportation connections, including additional crossings of the QEW. Infrastructure needed to accommodate pedestrians, cyclists, and vehicles, such as improving connections, enhancing the public realm, and establishing a mix of uses, have been identified. This EA study focused on developing transportation solutions to achieve the following:

- Improved access and circulation within Midtown Oakville (including the easterly extension of Cross Avenue)
- Additional north-south capacity over the QEW for vehicles, transit, cyclists and pedestrians
- Improved access to the QEW to and from the eastern section of the Midtown Oakville area
- Improved access from eastbound QEW to employment south and east of Trafalgar Road interchange
- Improved capacity on existing corridors:
  - Eighth Line, from Iroquois Shore Road to North Service Road
  - Iroquois Shore Road, from Trafalgar Road to Eighth Line
  - Chartwell Road, from Cornwall Road to South Service Road

Combination Options

A range of alternatives were identified and assessed through consultation with the public agency stakeholders for each road network improvement considered as part of this study. Through the development of alternatives for the above improvements, it was found that Improvements A, B, C and D (described below) were closely inter-related. Therefore, alternatives for these four improvements were developed in combination ("Combination Options"). Of all the various alternatives for Improvements A, B, C and D, four combination options were formulated.

Improvement A: North / South QEW Road Crossing and
Improvement C: North / South QEW Active Transportation / Priority Crossing

The QEW was identified to be a major barrier for north-south travel through the area. Trafalgar Road is the only existing crossing for cars, buses, trucks, cyclists, and pedestrians. Traffic analysis has shown that some intersections along Trafalgar Road are operating at capacity during peak periods. The safety of cyclists and pedestrians on Trafalgar Road has also been identified as an issue since this group is more negatively impacted by the crossing options of the QEW on/off ramps, where vehicles are accelerating on to a ramp or checking for gaps in traffic in order to merge and cyclists or pedestrians may be overlooked.

Improvement A considered an additional crossing of the QEW east of Trafalgar Road, which would accommodate all modes of transportation, while also providing an increased level of safety for crossing the QEW for pedestrians and cyclists.

Improvement C considered an additional crossing of the QEW east of Trafalgar Road for transit and active transportation only, which would improve transit operations and also provide an increased level of

safety for pedestrians and cyclists crossing the QEW. This improvement was considered in conjunction with Improvement A.

Improvement B: Trafalgar Road Interchange

With the anticipated growth and development in Midtown Oakville, and the need for improved connectivity and accessibility, a direct off-ramp from eastbound QEW to Midtown Oakville was considered. Improvements to the existing at-grade intersection of the eastbound QEW off-ramp at Trafalgar Road including an additional through movement and related road works were also considered.

Improvement D: Cross Avenue Extension

Improvement D considered various options for extending Cross Avenue / Davis Road easterly through Midtown Oakville. A continuous east-west road through Midtown Oakville will provide greater connectivity on both sides of Trafalgar Road and can be designed to accommodate all modes. Direct access can be provided to/from the QEW via Trafalgar Road and Royal Windsor Drive interchanges.

Improvement E: Iroquois Shore Road Widening

Improvement E considered widening Iroquois Shore Road to provide four travel lanes plus a centre turning lane, as well as bike lanes and sidewalks on both sides of the road. The alternatives for Improvement E included widening Iroquois Shore Road to the south, widening along the centreline and widening to the north.

Improvement F: Royal Windsor Drive Interchange

With the anticipated growth and development in Midtown Oakville, and need for improved connectivity and accessibility, improvements to Royal Windsor Drive interchange were considered as Iroquois Shore Road and Royal Windsor Drive are connected to create another crossing of the QEW east of Trafalgar Road.

The four alternatives for the Royal Windsor Driver interchange included new on and off ramps that build upon the existing partial interchange configuration. New ramps in one or more alternatives included a westbound QEW off-ramp, an eastbound QEW on-ramp, and a buttonhook off-ramp from eastbound QEW to provide direct access to Midtown Oakville.

Active Transportation Crossings

Active transportation crossings of the QEW, both east and west of Trafalgar Road, for pedestrians and cyclists were considered. New crossings for pedestrians and cyclists can encourage more active, sustainable modes of travel while increasing the safety of this group of road users.

Improvement G: East Active Transportation Crossing

Improvement G consisted of four alternatives to enhance the QEW crossing experience for pedestrians and cyclists on the east side of Trafalgar Road. All of the Improvement G alternatives feature separate rights-of-way for active transportation with variations in their starting and ending locations and, thus, the

number of QEW ramp crossings and potential for conflict with vehicles. All but one alternative features a direct connection to the Oakville GO station.

Improvement H: West Active Transportation Crossing

Improvement H consisted of four alternatives to enhance the QEW crossing experience for pedestrians and cyclists on the west side of Trafalgar Road. In anticipation of an active transportation crossing to the west of Trafalgar Road, a pier within the QEW right-of-way, approximately 300 m west of Trafalgar Road, was constructed as part of previous works on the QEW corridor that were completed in 2010. All of the west active transportation crossing alternatives provided a connection from the southwest corner of the Oakville Place and the adjacent residential neighbourhood to Midtown Oakville and the Oakville GO station.

F. Evaluation of Alternative Network Solutions

A detailed assessment of the alternative network solutions was completed based on the evaluation criteria. This section highlights only notable differences among alternatives. The complete evaluation matrix is provided in **Appendix F**.

Combination Options

Through the evaluation process, Combination Option #3 was selected as the preferred option. Option #3 best addresses the Problem / Opportunity Statement to develop Midtown Oakville into a "complete urban community", improve the existing transportation network to enhance growth and economic development opportunities (including creating new development parcels north of Iroquois Shore Road on the town hall lands), and provide a more balanced, accessible and sustainable transportation network for all modes of travel (walking, cycling, transit service and vehicles). By combining the North-South QEW Road Crossing and the North-South QEW Active Transportation / Priority Crossing, capital costs for this combination option are more efficiently utilized.

Iroquois Shore Road Widening

Through the evaluation process based on the established criteria, Improvement E2 – widening Iroquois Shore Road along the centreline – was selected as the preferred alternative. Widening along the centreline will result in less severe property impacts to existing properties on both sides of the road and will not significantly impact the existing land uses / social environment.

Royal Windsor Drive Interchange

Through the evaluation process based on the established criteria, Improvement F2 was selected as the preferred alternative as it best complied with land use planning goals and objectives given the environmental constraints, capital costs and staging requirements.

East Active Transportation Crossing

Improvement G2, which provides for a continuous connection for pedestrians and cyclists across all interchange ramps, was selected as the preferred alternative. This alternative eliminates conflicts between active transportation modes and vehicular traffic at the Trafalgar Road QEW interchange.

West Active Transportation Crossing

Improvement H2, which connects Oakville Place to Midtown Oakville, was selected as the preferred alternative. This alternative connects to Argus Road and the proposed multi-use trail adjacent to the new QEW off-ramp under Trafalgar Road into Midtown Oakville. This alternative provides the least skewed crossing of the QEW providing the shortest crossing distance.

G. Preferred Concept

The overall preferred concept, shown in **Figure ES-2**, is comprised of various elements including:

- A new North-South Crossing of QEW with designated transit lanes
- Improvements to Trafalgar Road QEW interchange
- Cross Avenue extension
- Iroquois Shore Road widening
- Improvements to Royal Windsor Drive interchange and extension of Royal Windsor Drive
- New pedestrian/cycling connections and facilities
- Improvements to transit connections and new transit facilities

To meet the need for additional north-south capacity over the QEW, the preferred concept provides a new crossing of the QEW midblock between Trafalgar Road and Eighth Line and an extension of Royal Windsor Drive over the QEW connect to Iroquois Shore Road at Eighth Line. The North-South Crossing is intended to accommodate passenger vehicles, transit on dedicated bus lanes, pedestrians and cyclists.

To accommodate QEW traffic to and from Midtown Oakville and to provide an alternate to Trafalgar Road interchange, several improvements are provided, including a direct off-ramp from eastbound QEW at Trafalgar Road and new ramps to/from the QEW at Royal Windsor Drive:

- A direct route from eastbound QEW to Midtown Oakville is provided via a new off-ramp that crosses under Trafalgar Road. This reduces the impacts of future traffic demand on the existing constrained intersections along Trafalgar Road at the off-ramp as well as at Cross Avenue. The underpass of Trafalgar Road also provides the opportunity for improved active transportation connections into Midtown Oakville.
- A direct route from eastbound QEW to Midtown Oakville is provided via a new off-ramp to Cross Avenue at the Royal Windsor Drive interchange. A direct route from Midtown Oakville to eastbound QEW is provided via a new on-ramp at Royal Windsor Drive opposite Cross Avenue. A new westbound QEW off-ramp at Royal Windsor Drive will provide an alternative route to Midtown Oakville and surrounding areas.

For access and circulation within Midtown Oakville, Cross Avenue is extended from Trafalgar Road to Royal Windsor Drive, where it connects with the enhanced QEW interchange. Cross Avenue will be the new "main street" for Midtown Oakville with streetscaping and built form elements that provide accessible facilities for pedestrians and cyclists to travel safely, on-street parking where appropriate, and four lanes of vehicular travel.

Improved capacity is provided on Iroquois Shore Road by widening of the road to a 4-lane cross-section plus a centre-turning lane, with on-street bike lanes and sidewalks on both sides. Iroquois Shore Road connects with the extension of Royal Windsor Drive providing one continuous corridor.

Additional connections to the proposed new transit station are provided in the form of designated transit lanes that connect the proposed Trafalgar BRT via the North-South Crossing and continuing on to the transit station. Additionally, transit-only access from Cross Avenue extension to the proposed transit station will be provided.

Additional links for pedestrians and cyclists are provided by two grade-separated, active transportation crossings of the QEW – one west of Trafalgar Road and one east of Trafalgar Road. These crossings will meet required accessibility design standards and enhance the safety of those wishing to cross the QEW on foot or by bicycle. These active transportation crossings provide pedestrians and cyclists with alternatives for crossing the QEW and improved access to transit.

H. Design

An iterative process that included traffic analysis and design criteria was undertaken, with input from MTO, technical agencies and the public, to develop the design for the preferred concept as shown in **Figure ES-3**. The preliminary design includes the following:

Improvements to the QEW Trafalgar Road Interchange

- Realignment of the existing eastbound QEW off-ramp
- New eastbound QEW direct off-ramp to Cross Avenue
- New multi-use trail from Argus Road to Cross Avenue under Trafalgar Road
- Realignment of South Service Road
- Realignment of Argus Road

Improvements to the QEW Royal Windsor Drive Interchange

- New westbound QEW off-ramp
- New eastbound QEW on-ramp, including auxiliary lane to Ford Drive off-ramp
- Realignment of eastbound QEW off-ramp
- New QEW eastbound direct off-ramp to Cross Avenue
- Widening and extension of Royal Windsor Drive to Iroquois Shore Road at Eighth Line
- Realignment of North Service Road
- Realignment of South Service Road

New North-South Crossing across QEW

- Provides pedestrian / cyclist facilities
- Provides dedicated bus lanes
- Provides general purpose lanes
- Accommodates potential widening of the QEW that may be contemplated by MTO

Extension of Cross Avenue

- New connection from Trafalgar Road to Royal Windsor Drive
- Provides pedestrian / cyclist facilities
- Provides general purpose lanes
- Accommodates lay-by parking where appropriate

Widening of Iroquois Shore Road

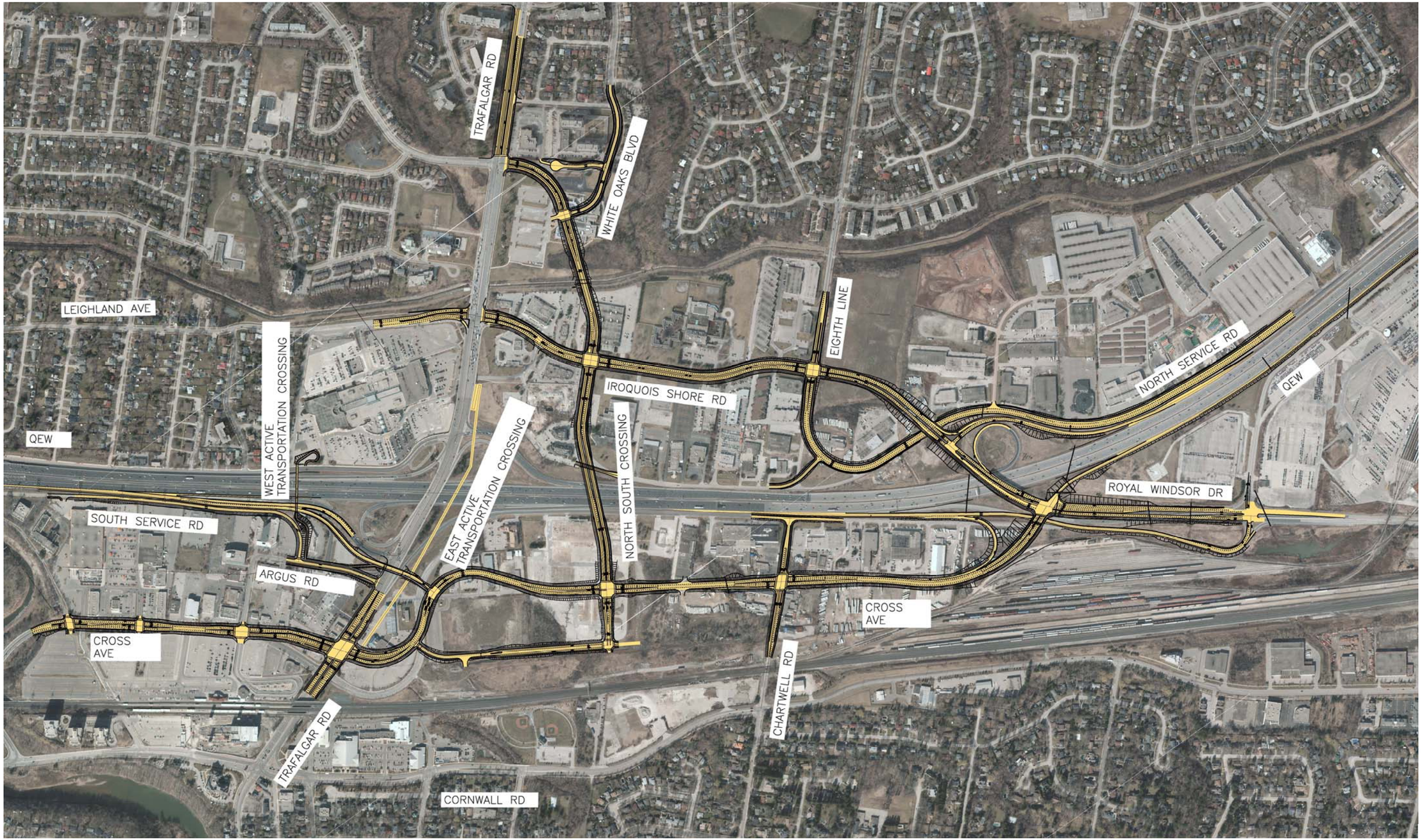
- Provides continuous pedestrian / cyclist facilities on both sides of the road
- Accommodates one additional general purpose lane in each direction plus a median turn lane

Active Transportation Crossings across QEW

- Active Transportation Crossing of QEW on the east side of Trafalgar Road
- Active Transportation Crossing of QEW on the west side of Trafalgar Road

Figure ES-2: Preferred Concept Plan

Figure ES-3: Preliminary Design of Preferred Concept



J. Stormwater Management

Proposed Conditions

The proposed drainage conditions of the Midtown Oakville study area resulting from the proposed transportation and land use improvements were simulated using a Visual OTTHYMO (VO2) hydrology model. The proposed conditions VO2 model was used to determine the storage for each of the four subwatersheds required to meet the target flow rates. As part of the preferred alternative, a diversion of some of the drainage from the Lower Morrison Creek watershed to the Sixteen Mile Creek watershed was also considered, as there are currently major flooding and erosion issues within the Lower Morrison and Wedgewood Creeks. This diversion was assessed at a high level in order to determine the feasibility and benefits to decreasing flows in Lower Morrison Creek. The analysis done as part of this Class EA for the proposed diversion indicates that the hydrological benefits of the proposed diversion are limited as the total combined storage requirements for both of the Lower Morrison Creek and Sixteen Mile Creek subwatersheds are not significantly reduced with the proposed diversion. It is therefore not proposed to implement the diversion at this time, but the diversion may be reconsidered in the future.

Preliminary Stormwater Management Criteria

The stormwater management (SWM) analysis includes recommendations on preliminary SWM criteria for any future development within the Midtown Oakville study area. The predominant focus of the preliminary SWM criteria recommended as part of this Class EA is on setting flow targets for each of the subwatersheds within the Midtown Oakville study area, with a preliminary assessment of water quality, erosion control and water balance requirements. Preliminary SWM criteria developed were:

- Future development or transportation improvement within the study area is to utilize the Midtown Oakville EA Study hydrology model in order to demonstrate that the target flows are met for each subwatershed;
- Any future development or transportation improvement within the Midtown Oakville study area is to also achieve Enhanced Level 1 Protection, as per the Ministry of Environment's (MOE) *Stormwater Management Planning and Design Manual* (March 2003);
- Any future development or transportation improvement within the Midtown Oakville study area is also to provide water balance controls by achieving the greater of either of the two following requirements:
  - Provide retention of 5 mm over the entire area of the proposed development, as per the City of Toronto's Wet Weather Flow Management Guidelines (November 2006) ; or
  - Retain stormwater on-site to achieve an equivalent annual volume of infiltration as pre-development conditions, as per Section 3.2 of the MOE Stormwater Management Planning and Design Manual (March 2003).

This water balance objective could be achieved by a variety of low impact development (LID) measures, as specified in the Low Impact Development Stormwater Management Planning and Design Guide, prepared by Credit Valley Conservation and Toronto and Region Conservation Authority (2010). Implementation of the water balance criteria will provide inherent in terms of reduction of downstream erosion through a decrease in runoff from frequent rainfall events. It should be noted that the town intends

to complete a separate flood study in the near future which will confirm the final SWM criteria for the Midtown Oakville study area.

Hydraulics

Hydraulic analysis was completed for the Morrison/Wedgewood Diversion Channel and the Lower Morrison Creek in order to evaluate the hydraulic impacts resulting from the proposed transportation improvements. The hydraulic analysis was done using a HEC-RAS model for each watercourse. The purpose of the hydraulic analysis was to demonstrate that there are no significant hydraulic impacts as a result of the proposed transportation improvements. Only the proposed major crossings of these watercourses were analyzed during the current study, with assessment of smaller crossings and linear drainage systems to be completed during future design phases. As part of the proposed transportation improvements, two new major watercourse crossings will be required at:

- Morrison/Wedgewood Diversion Channel approximately 240 m east of Trafalgar Road; and,
- Lower Morrison Creek approximately 150 m south of QEW.

The analysis completed during this study has demonstrated that it is feasible to implement new crossings that meet Conservation Halton's criteria. During subsequent detailed design phases, crossing sizes would be optimized to maximize cost efficiencies while meeting all appropriate criteria.

Improvement H4 – This alternative was not preferred for the following reasons:
- Less direct route for pedestrians originating from or destined to Oakville Place.
- Impacts trees/parklands in Pearson Park.

5.3. Preferred Concept

The overall preferred concept, shown in **Figure 5-1**, is comprised of the various preferred elements described in the previous section including:
- A new north-south crossing of QEW with transit lanes and active transportation facilities
- Improvements to the Trafalgar Road QEW interchange
- Cross Avenue extension
- Iroquois Shore Road widening
- Improvements to Royal Windsor Drive QEW interchange and extension of Royal Windsor Drive
- New pedestrian/cycling connections and facilities, including two active transportation crossings of the QEW
- Improvements to transit connections and new transit facilities

To meet the need for additional north-south crossing opportunities over the QEW, the preferred concept provides a new crossing of the QEW midblock between Trafalgar Road and Eighth Line and an extension of Royal Windsor Drive over the QEW to Eighth Line. The new North-South Crossing is intended to accommodate passenger vehicles, transit on dedicated bus lanes, pedestrians and cyclists.

To accommodate traffic to and from Midtown Oakville and to provide an alternate to Trafalgar Road, several improvements are provided, including a direct off-ramp from eastbound QEW at Trafalgar Road and new ramps to/from the QEW at Royal Windsor Drive:
- A direct route from eastbound QEW to Midtown Oakville is provided via a new off-ramp that crosses under Trafalgar Road. This reduces the impacts of future traffic demand on the existing constrained intersections along Trafalgar Road at the off-ramp as well as at Cross Avenue. The underpass of Trafalgar Road also provides the opportunity for improved active transportation connections into Midtown Oakville.
- A direct route from eastbound QEW to Midtown Oakville is provided via a new off-ramp to Cross Avenue at the Royal Windsor Drive interchange. A direct route from Midtown Oakville to eastbound QEW is provided via a new on-ramp at Royal Windsor Drive opposite Cross Avenue. A new westbound QEW off-ramp at Royal Windsor Drive will provide an alternative route to Midtown Oakville and surrounding areas.

For access and circulation within Midtown Oakville, Cross Avenue is extended from Trafalgar Road to Royal Windsor Drive, where it connects with the enhanced QEW interchange. Cross Avenue will be the new “main street” for Midtown Oakville with streetscaping and built form elements that provide accessible facilities for pedestrians and cyclists to travel safely, on-street parking where appropriate, and four lanes of vehicular travel.

Figure 5-1: Preferred Concept Plan

Improved capacity is provided on Iroquois Shore Road by widening of the road to a 4-lane cross-section plus a centre-turning lane, with on-street bike lanes and sidewalks on both sides. Iroquois Shore Road connects with the extension of Royal Windsor Drive providing one continuous corridor.

Additional connections to the proposed new transit station are provided in the form of designated transit lanes that connect the proposed Trafalgar BRT via the North-South Crossing and continuing on to the transit station. Additionally, transit-only access from Cross Avenue extension to the proposed transit station will be provided.

Additional links for pedestrians and cyclists are provided by two grade-separated, active transportation crossings of the QEW – one west of Trafalgar Road and one east of Trafalgar Road. These crossings will meet required accessibility design standards and enhance the safety of those wishing to cross the QEW on foot or by bicycle. These active transportation crossings provide pedestrians and cyclists with alternatives for crossing the QEW and improved access to transit.

5.4. Future Traffic Operations of Preferred Concept

Traffic analysis of the preferred concept was undertaken to refine the design and configuration of the preferred concept. Intersection analysis was undertaken to assess operations and queue storage needs. A microsimulation model was undertaken to assess the impacts of new interchange ramps on the QEW and at the ramp intersections.

Intersection Operations

The preferred concept will operate with improved levels of service compared to the "Do Nothing" scenario (see Section 3.2.2), however, some capacity constraints will persist. The intersections of Trafalgar Road / Cross Avenue and Trafalgar Road / Cornwall Road will both operate at capacity (LOS E) even with the proposed network improvements. It is noted that these intersections all failed (LOS F) in the "Do Nothing" scenario. On the whole, the preferred concept for Midtown Oakville provides much needed capacity to the transportation network.

Freeway Operations

The proposed improvements are not expected to significantly impact the QEW mainline operations with the refinements to the design to better accommodate weaving and merging. The new ramps at Royal Windsor Drive and Trafalgar Road will accommodate the additional travel demand from Midtown Oakville's planned intensification thereby providing relief to the existing Trafalgar Road interchange.

Figure 5-2: AM Preferred Concept Intersection Operations

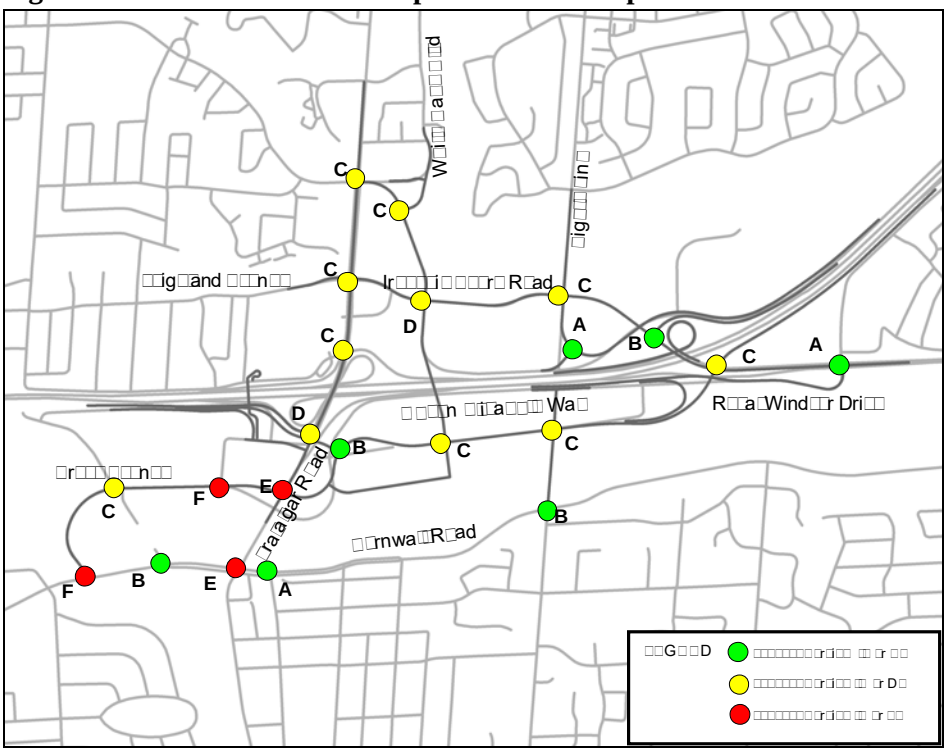
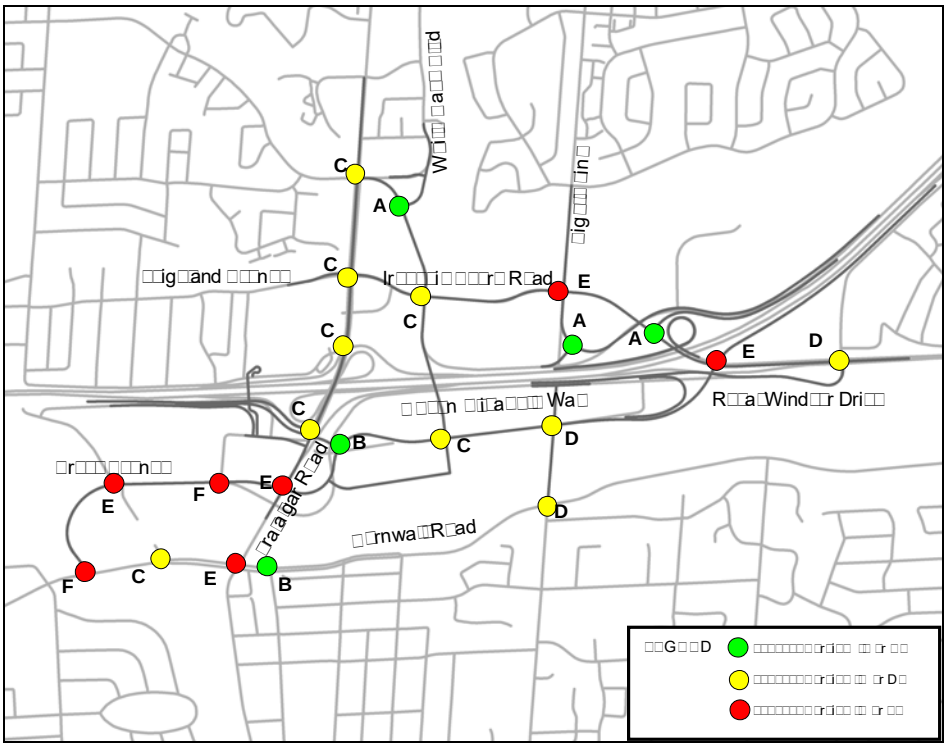


Figure 5-3: PM Preferred Concept Intersection Operations



5.5. Modifications to Preferred Concept

The preliminary design for the preferred concept (see **Section 6**) incorporates features that address traffic operations and a number of concerns brought forth by MTO regarding future operations on QEW mainline.

Through an iterative process using the microsimulation model and consultation with MTO, modifications and refinements related to the design of the provincial facilities in the preferred concept include:

- A full auxiliary lane from the new eastbound QEW on-ramp at Royal Windsor Drive to the off-ramp at Ford Drive.
- Increased acceleration lane where the eastbound QEW off-ramp to Cross Avenue (W-Cross Avenue Ramp) at the Royal Windsor Drive interchange merges with Cross Avenue.
- Widening of the westbound QEW off-ramp (E-NS ramp) at Royal Windsor Drive to provide sufficient sight distance to the bullnose.
- Addition of a channelized right-turn at the new westbound QEW off-ramp (E-NS ramp) at Royal Windsor Drive.
- Increased deceleration length for the eastbound QEW off-ramp to Cross Avenue (W-Cross ramp) at Trafalgar Road interchange.
- Turn lane configuration at the two signalized interchange intersections on Royal Windsor Drive.

Additional refinements to the preferred concept were adopted to accommodate traffic and transit operation needs, which include:

- Widening of Cross Avenue from Trafalgar Road extends westerly to Lyons Lane.
- Widening of Chartwell Road at Cross Avenue.
- Realignment of Leighland Avenue at Trafalgar Road to accommodate the widening of Iroquois Shore Road.
- Replacement of roundabout on Cross Avenue at the QEW off-ramp with a t-intersection that has Cross Avenue has the major road and the QEW off-ramp as the minor road.
- Transit-only access (right-in / right-out) on Cross Avenue providing access to the bus loop and transit station.
- Realignment of North Service Road to Eighth Line.
- Realignment of White Oaks Boulevard to intersect with the North-South Crossing at a location that accommodates a future four-legged intersection and potential for signalization.
- Realignment of North Service Road to accommodate the new westbound QEW off-ramp (E-NS ramp) at Royal Windsor Drive interchange.

The preliminary design of the preferred concept is discussed in detail in **Section 6**.

6. Design Elements of the Preferred Concept

This section describes the engineering features and mitigation measures for the preferred concept identified in **Section 5**. The preferred concept for Midtown Oakville was developed and refined with input from the project team, technical agencies, and various stakeholders, and includes the following:

Improvements to the QEW Trafalgar Road Interchange

- Realignment of the existing eastbound QEW off-ramp
- New eastbound QEW direct off-ramp to Cross Avenue
- New multi-use trail from Argus Road to Cross Avenue under Trafalgar Road
- Realignment of South Service Road
- Realignment of Argus Road

Improvements to the QEW Royal Windsor Drive Interchange

- New westbound QEW off-ramp
- New eastbound QEW on-ramp, including auxiliary lane to Ford Drive off-ramp
- Realignment of eastbound QEW off-ramp
- New eastbound QEW direct off-ramp to Cross Avenue
- Widening and extension of Royal Windsor Drive to to Iroquois Shore Road at Eighth Line
- Realignment of North Service Road
- Realignment of South Service Road

New North-South Crossing across QEW

- Provides pedestrian / cyclist facilities
- Provides dedicated bus lanes
- Provides general purpose lanes
- Accommodates potential widening of the QEW that may be contemplated by MTO

Extension of Cross Avenue

- New connection from Trafalgar Road to Royal Windsor Drive
- Provides pedestrian / cyclist facilities
- Accommodates general purpose lanes
- Accommodates lay-by parking where appropriate

Widening of Iroquois Shore Road

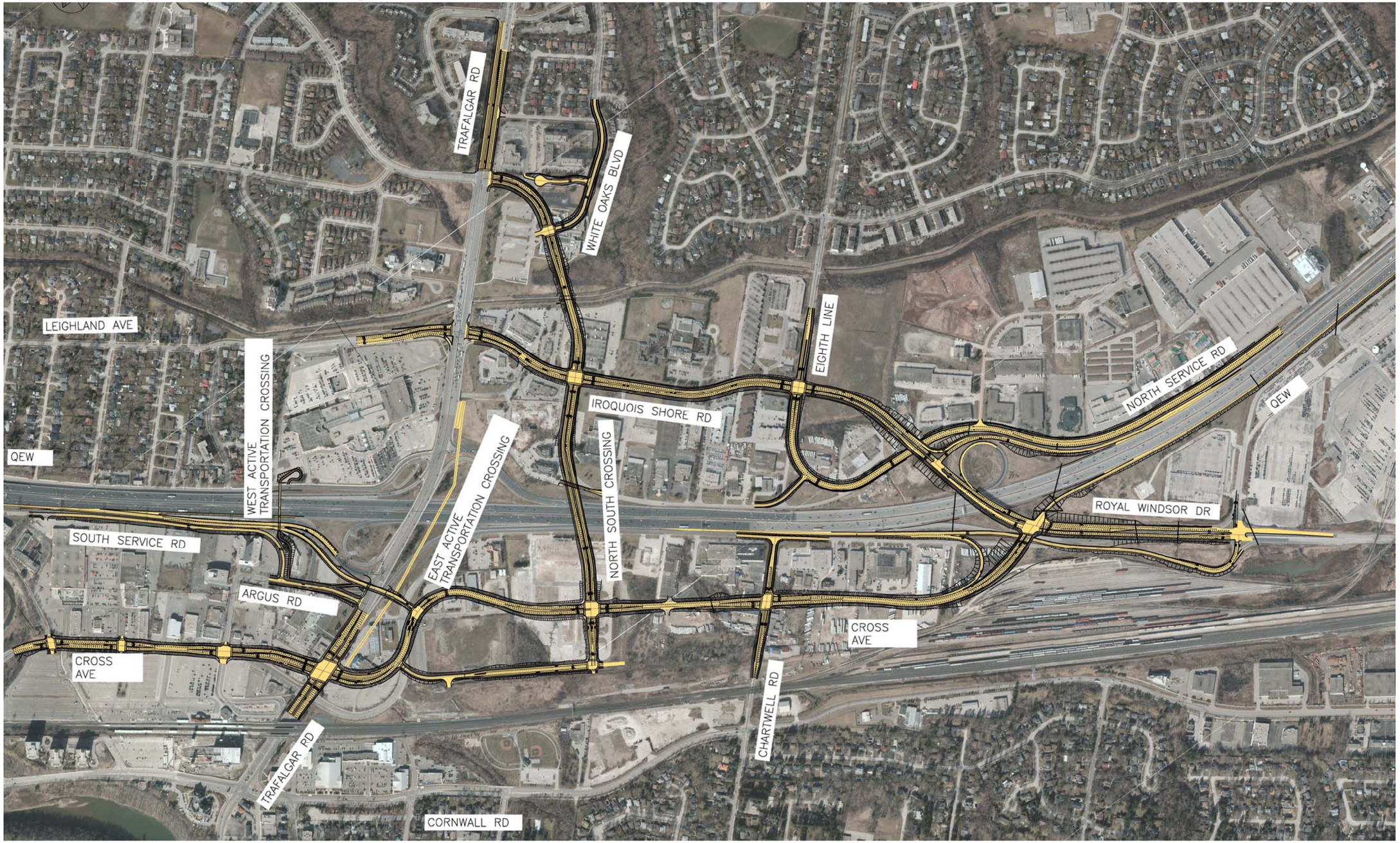
- Provides continuous pedestrian / cyclist facilities on both sides of the road
- Accommodates one additional general purpose lane in each direction plus a median turn lane

Active Transportation Crossings across QEW

- Active transportation crossing of QEW on the east side of Trafalgar Road
- Active transportation crossing of QEW on the west side of Trafalgar Road

Figure 6-1 shows the overall preliminary design of the recommended concept for Midtown Oakville.

Figure 6-1: Preliminary Design of Recommended Concept



6.1. Road Characteristics and Typical Sections

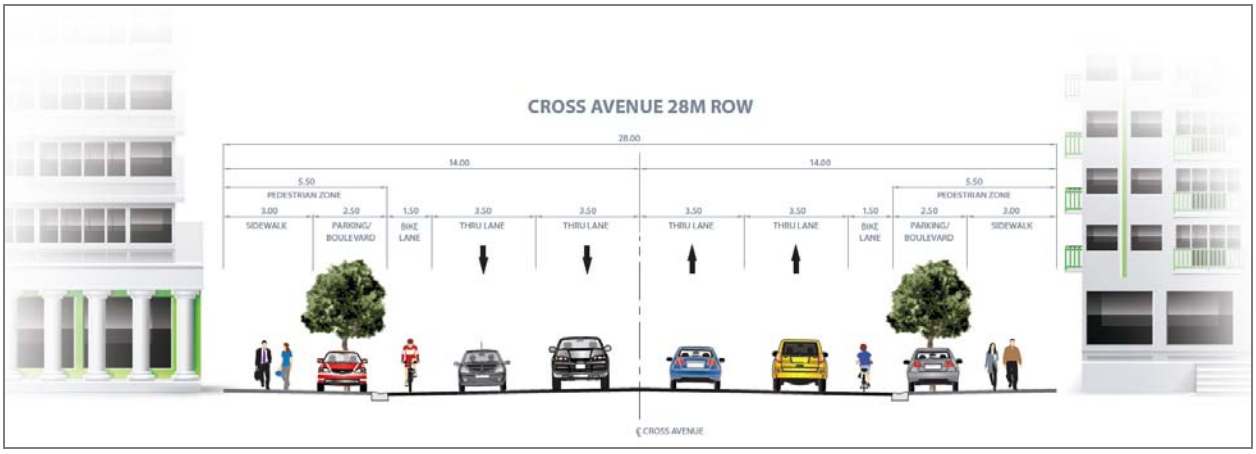
Midtown Oakville is to be transformed into a complete mixed use community with offices, condominiums, civic spaces, parks and plazas. Roadways are envisaged as main streets or commercial/employment corridors with accommodation for pedestrians, cyclists, public transit, and general purpose traffic. A description of the role and function of the roadways in Midtown Oakville are provided below.

6.1.1. Cross Avenue

Cross Avenue is proposed to be the "main street" for Midtown Oakville. It will be a multi-modal corridor serving pedestrians, cyclists, public transit, and general purpose traffic. West of Trafalgar Road, Cross Avenue will have more of a pedestrian-focused streetscape. East of Trafalgar Road, the extension of Cross Avenue will primarily serve commercial/employment lands.

Within the proposed right-of-way of 28 m, Cross Avenue will have four 3.5 m general purpose travel lanes, two 1.5 m bike lanes, and 5.5 m boulevards as shown in **Figure 6-2**. The 5.5 m boulevards are intended to include 3.0 m sidewalks and 2.5 m lay-by parking. In areas without lay-by parking, the full 5.5 m boulevard is designated as a pedestrian zone.

Figure 6-2: Cross Avenue Cross-section



6.1.2. North-South Crossing

The North-South Crossing is proposed to be a multi-modal corridor serving transit, cyclists, pedestrians, and general purpose traffic. Reserved bus lanes are proposed from Trafalgar Road to the proposed bus loop located on the east side of Trafalgar Road. North of Iroquois Shore Road, the North-South Crossing will have a 28 m right-of-way. South of Iroquois Shore Road, the North-South Crossing will need a 32 m right-of-way to accommodate median turn lanes.

The close proximity of the eastbound QEW off-ramp will require retaining structures to overcome the grade differences between the eastbound QEW off-ramp profile and the direct off-ramp to Cross Avenue profile. A minimum vertical structural clearance of 4.8 m will be provided at the Trafalgar Road underpass in accordance with the MTO Geometric Design Manual.

6.2.2. Cross Avenue

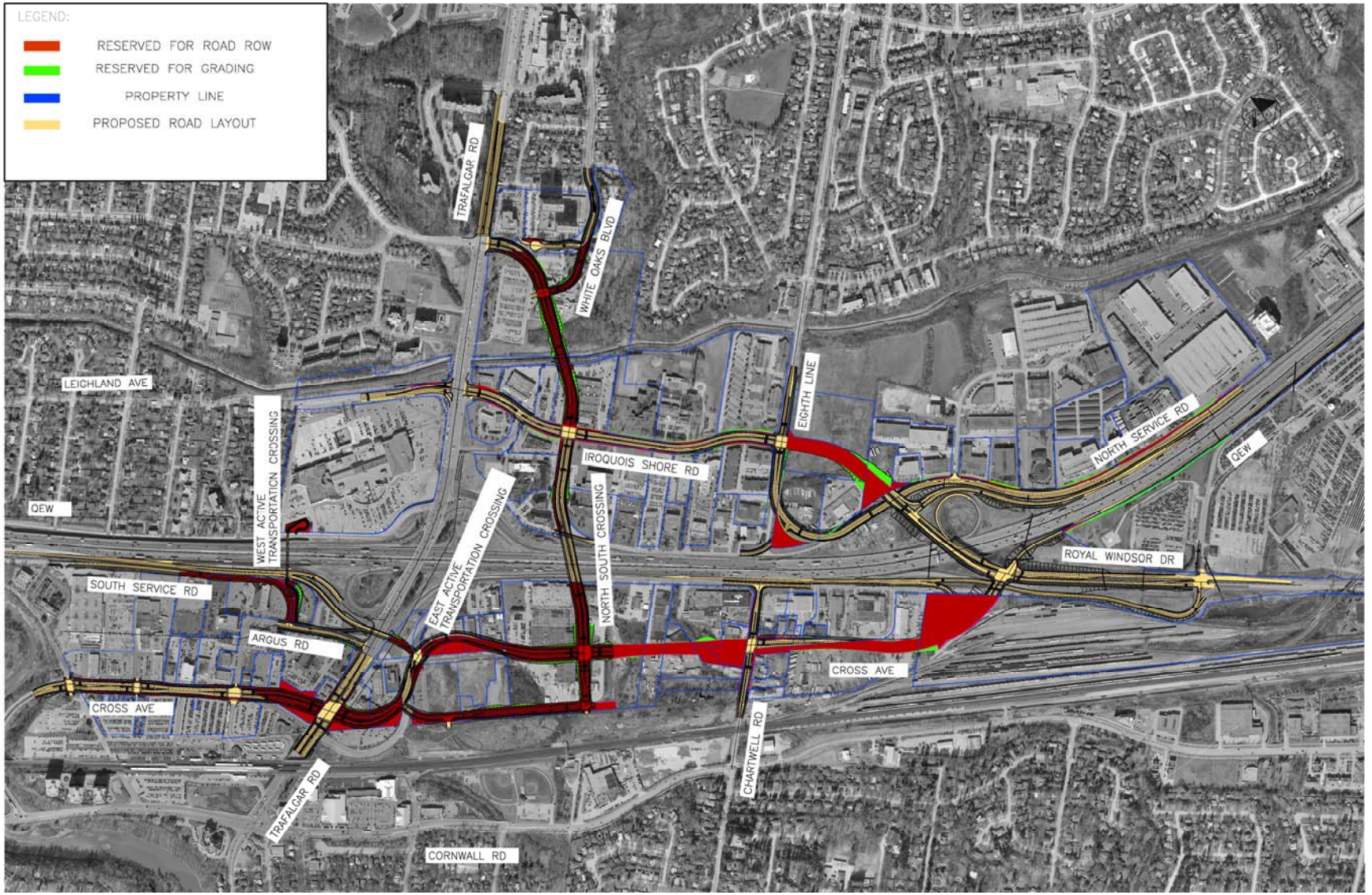
Figure 6-9 shows a rendering of the proposed extension of Cross Avenue looking from the east to the west at the proposed intersection with the North-South Crossing.

Figure 6-9: Cross Avenue

The horizontal alignment of Cross Avenue from Lyons Lane to Argus Road will be consistent with the existing horizontal alignment to minimize impacts to existing properties along the corridor. From this point easterly, the alignment will traverse a new path through the Midtown Oakville study area towards Royal Windsor Drive. The realignment of Cross Avenue will facilitate the construction of a new bus terminal on the east side of Trafalgar Road. A minimum horizontal radius of 115 m is proposed for the ramp (with a 2% super elevation) in accordance with the requirements of the TAC Design Manual.

The vertical alignment of Cross Avenue will match the existing road profile from Lyons Lane to the intersection of Argus Road. From this point easterly to the QEW off-ramp intersection, the road profile will be reflective of the existing ground elevations. To accommodate the North-South Crossing and the new culvert crossing of the Lower Morrison Creek, the Cross Avenue profile will need to rise by 1.5 m above the existing ground. Chartwell Road will be matched at its existing elevation. From Chartwell

Figure 6-14: Property Requirements



7. Stormwater Management

Cole Engineering completed an assessment of the hydrologic and hydraulic impacts of the preferred alternative of transportation improvements as part of the Class EA study for Midtown Oakville. A Stormwater Management Report was prepared by Cole Engineering (May 2014), which is provided in **Appendix J**. The purpose of the Stormwater Management Report was to discuss the hydrologic and hydraulic impacts of the preferred concept, provide recommendations for stormwater management (SWM) within the Midtown Oakville study and advise on preliminary watercourse crossing requirements for the proposed transportation improvements within the study area. The hydrologic and/or hydraulic impacts of the proposed improvements were assessed for each of the following four subwatersheds within the Midtown Oakville study area:

- Lower Morrison Creek
- Wedgewood Creek
- Morrison/Wedgewood Diversion Channel
- Sixteen Mile Creek

Preliminary SWM criteria are recommended as part of this Class EA, with a predominant focus on setting peak flow targets for each of the subwatersheds within the Midtown Oakville study area, and a preliminary assessment of water quality, erosion control and water balance. CH was engaged during the study, and site visits were carried out to discuss any concerns regarding the various transportation improvement alternatives. CH was also part of the TAC and participated in the Agency Stakeholders Workshop.

7.1. Existing Conditions and Target Flows

The existing drainage conditions of the Midtown Oakville study area were simulated using a Visual OTTHYMO (VO2) hydrology model. The hydrologic parameters were determined for each drainage catchment within the Midtown Oakville study area, including the assessment of current imperviousness determined based on the land use of each catchment. The drainage area plan for existing conditions is shown in **Figure 3-9**.

As per the *Lower Morrison/Wedgewood Creeks – Flood, Erosion and Master Drainage Plan Study* prepared by R. V. Anderson Associates Ltd. (January 1993), there are downstream hydraulic capacity constraints which must be considered when establishing allowable discharge rates from all new developments within the Lower Morrison Creek and Wedgewood Creek subwatersheds. As per the R. V. Anderson creek study, peak runoff rates from all new development within the Lower Morrison Creek and Wedgewood Creek watersheds are to be controlled to 50% of pre-development levels in order to mitigate potential erosion and flooding. The existing flows resulting from the VO2 hydrologic model applied at 50% were compared to the existing (1993) flows provided in the R.V Anderson creek study. It was noted during the comparison of these flows that the existing flow results from VO2 for Lower Morrison Creek applied at 50% exceed the existing (1993) flows from the R.V. Anderson creek study. This is a result of the higher imperviousness values that were determined as part of the hydrologic analysis conducted for

this Class EA. Therefore the existing (1993) flows from the R.V. Anderson study will be used at the target flows for Lower Morrison Creek. The target flows for Wedgewood Creek will remain at 50% of the flows from the existing conditions VO2 model, as these target flows do not exceed the existing (1993) flows for Wedgewood Creek as per the R.V. Anderson creek study.

It is also indicated in the *Morrison/Wedgewood Diversion Channel – Spill Control Class Environmental Assessment*, prepared by AMEC Environment & Infrastructure (May 2012), that there is a current potential for a spill of flood waters during extreme storm conditions which potentially affect those lands within the vicinity of the diversion channel, as well as properties further downstream. However, work is currently being undertaken by CH in order to mitigate these flood impacts of the diversion channel. Therefore, as part of the stormwater management analysis completed for this Class EA, it is recommended that peak runoff rates from any future development within the Morrison/Wedgewood Diversion Channel be controlled to existing conditions.

As there are no existing flood concerns for Sixteen Mile Creek in the study area, peak runoff rates from all future developments within the Sixteen Mile Creek watershed are to be controlled to existing flow rates.

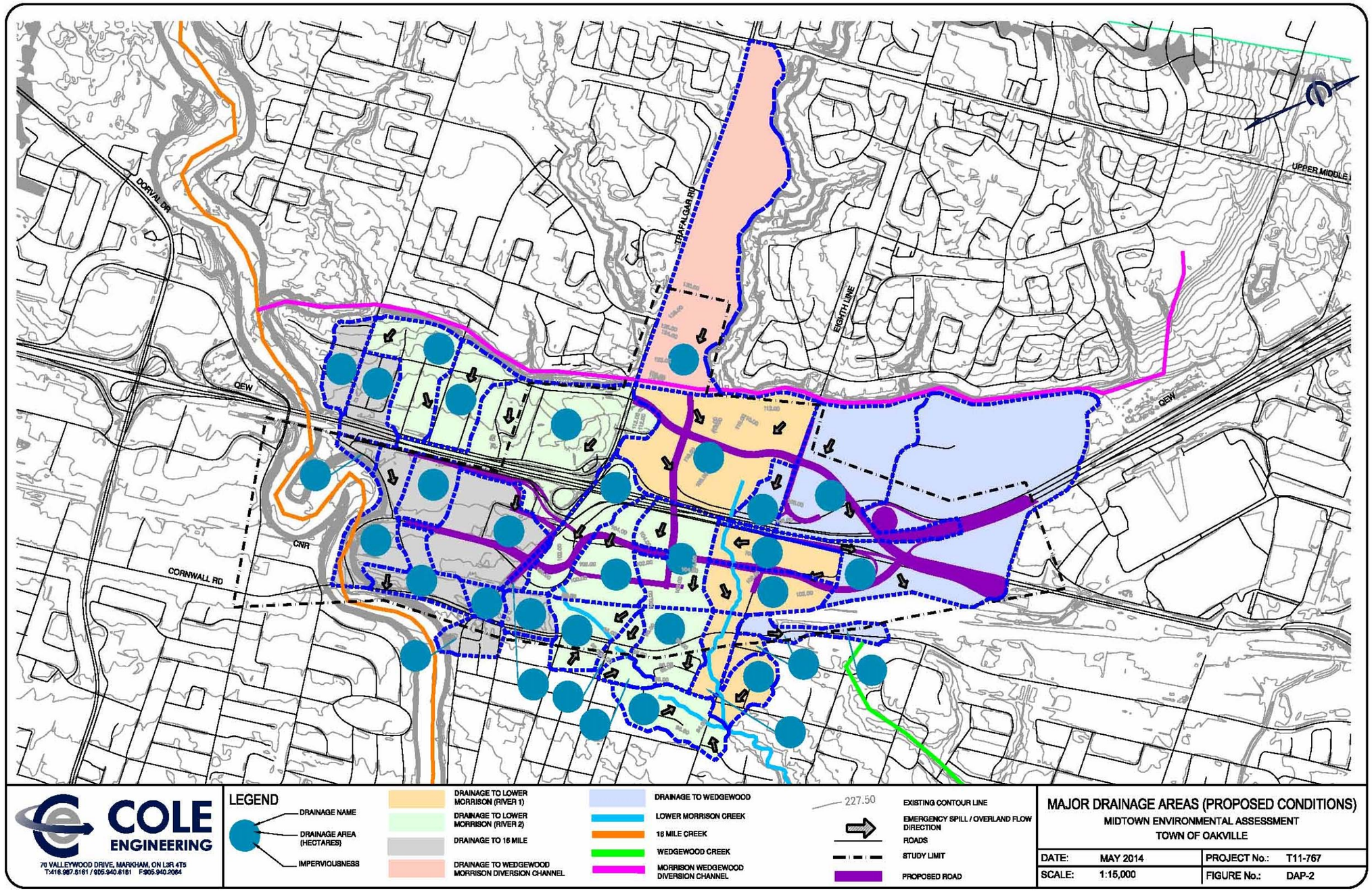
7.2. Proposed Conditions

The proposed drainage conditions of the Midtown Oakville study area resulting from the proposed transportation improvements were also simulated using a Visual OTTHYMO (VO2) hydrology model. The drainage area plan for proposed conditions is shown in **Figure 7-1**.

The proposed conditions VO2 model was used to determine the storage for each of the four subwatersheds required to control the proposed transportation improvements to the target flow rates discussed in **Section 7.1**. As part of the preferred alternative, a diversion of some of the drainage from the Lower Morrison Creek watershed to the Sixteen Mile Creek watershed is also considered, as there are currently flooding and erosion issues within the Lower Morrison and Wedgewood Creeks.

This diversion was assessed at a high level in order to determine the feasibility and benefits to decreasing flows in Lower Morrison Creek. This assessment consisted of a hydrologic review only, and if this diversion is to be considered further, the resulting impacts to ecology and base flows should be assessed under separate cover. It is noted that the environmental assessment requirements for this diversion are not covered within the Midtown Oakville Class EA, and that a separate study would be required to satisfy environmental assessment requirements. If the subsequent EA was to confirm the diversion, drainage would be diverted to Sixteen Mile Creek via a storm pipe along the proposed Cross Avenue road. As discussed in the SWM Report provided in **Appendix J**, the hydrological benefits of the proposed diversion are limited as the total combined storage requirements for both of the Lower Morrison Creek and Sixteen Mile Creek subwatersheds is not significantly reduced with the proposed diversion. It is therefore not proposed to implement the diversion at this time, but the diversion may be reconsidered in the future.

Figure 7-1: Drainage Area Plan



7.3. Preliminary SWM Criteria

The SWM analysis completed as part of this Class EA Report also includes recommendations on preliminary SWM criteria for any future development within the Midtown Oakville study area. As previously noted, the predominant focus of the preliminary SWM criteria recommended as part of this Class EA is on setting flow targets for each of the subwatersheds within the Midtown Oakville study area, with a preliminary assessment of water quality, erosion control and water balance requirements. As discussed in the Stormwater Management Report, provided in **Appendix J**, it is recommended that any future development or transportation improvement within the study area is to utilize the Midtown Oakville EA study hydrology model in order to demonstrate that the target flows specified in the Stormwater Management Report are met for each subwatershed. Any future development and transportation improvement within the Midtown Oakville study area is to also achieve Enhanced Level 1 Protection, as per the MOE Stormwater Management Planning and Design Manual (March 2003). Any future development or transportation improvement within the Midtown Oakville study area is also to provide water balance controls by achieving the greater of either of the two following requirements:

- Provide retention of 5 mm over the entire area of the proposed development, as per the City of Toronto's *Wet Weather Flow Management Guidelines* (November 2006); or
- Retain stormwater on-site to achieve an equivalent annual volume of infiltration as pre-development conditions, as per Section 3.2 of the MOE *Stormwater Management Planning and Design Manual* (March 2003).

This water balance objective could be achieved by a variety of low impact development (LID) measures, as specified in the Low Impact Development Stormwater Management Planning and Design Guide, prepared by Credit Valley Conservation and Toronto and Region Conservation Authority (2010).

The existing Midtown Oakville area is highly impervious with limited SWM controls, and no known LID measures. This results in the generation and discharge of runoff during the majority of rainfall events, and would contribute to downstream erosion. Although a SWM criterion for erosion control was not assessed as part of the SWM analysis for this Class EA, from a practical perspective, it is anticipated that the water balance criteria will provide inherent benefits that will ensure that downstream erosion is decreased through development of Midtown Oakville.

It should be noted that the town intends to complete a separate flood mitigation opportunities study in the near future which will confirm the final SWM criteria for the Midtown Oakville study area.

7.4. Hydraulics

As discussed in the Stormwater Management Report provided in **Appendix J**, hydraulic analysis was completed for the Morrison/Wedgewood Diversion Channel and the Lower Morrison Creek in order to evaluate the hydraulic impacts resulting from the proposed transportation improvements. The hydraulic analysis was completed using a HEC-RAS model for each watercourse. The purpose of the hydraulic analysis is to demonstrate that there are no significant hydraulic impacts as a result of the proposed

transportation improvements. Only the proposed major crossings of these watercourses were analyzed during the current study, with assessment of smaller crossings and linear drainage systems to be completed during future design phases.

As part of the proposed transportation improvements, a crossing over the Morrison/Wedgewood Diversion Channel is proposed approximately 240 m east of Trafalgar Road. Due to the proximity of the proposed crossing location to Trafalgar Road, the preliminary sizing of the crossing was done using the same geometry as the existing Trafalgar Road crossing which has a total span of 8.0 m and a height of 3.0 m. Also, as part of the proposed transportation improvements, a crossing over the Lower Morrison Creek is proposed approximately 150 m south of the QEW. The proposed crossing of the Lower Morrison Creek is to be a precast concrete arch structure with an open bottom, with span of 9.8 m wide, and a height of 2.4 m. These proposed crossings were sized to minimize any hydraulic impacts to the existing watercourses.

As per CH criteria, under all flow conditions, up to and including flows generated by the regulatory storm, the crossing (including all required grading) will not result in any negative impacts to any existing habitable structure, and will provide safe access and egress to adjacent properties and roadways, for the duration or frequency of any spill. Any local water level increases may be accepted provided that:

- There is either no increased regulation of adjacent private properties; or
- The impacted private landowners have been given an understanding of how the proposed works will impact their property, the regulatory implications this will have on their future land use of the property, and have provided written confirmation of their understanding and acceptance of these impacts.

The analysis completed during the Midtown Oakville Class EA process has demonstrated that it is feasible to implement new crossings that meet CH's criteria. During subsequent detailed design phases, crossing sizes would be optimized to maximize cost efficiencies while meeting all appropriate criteria.

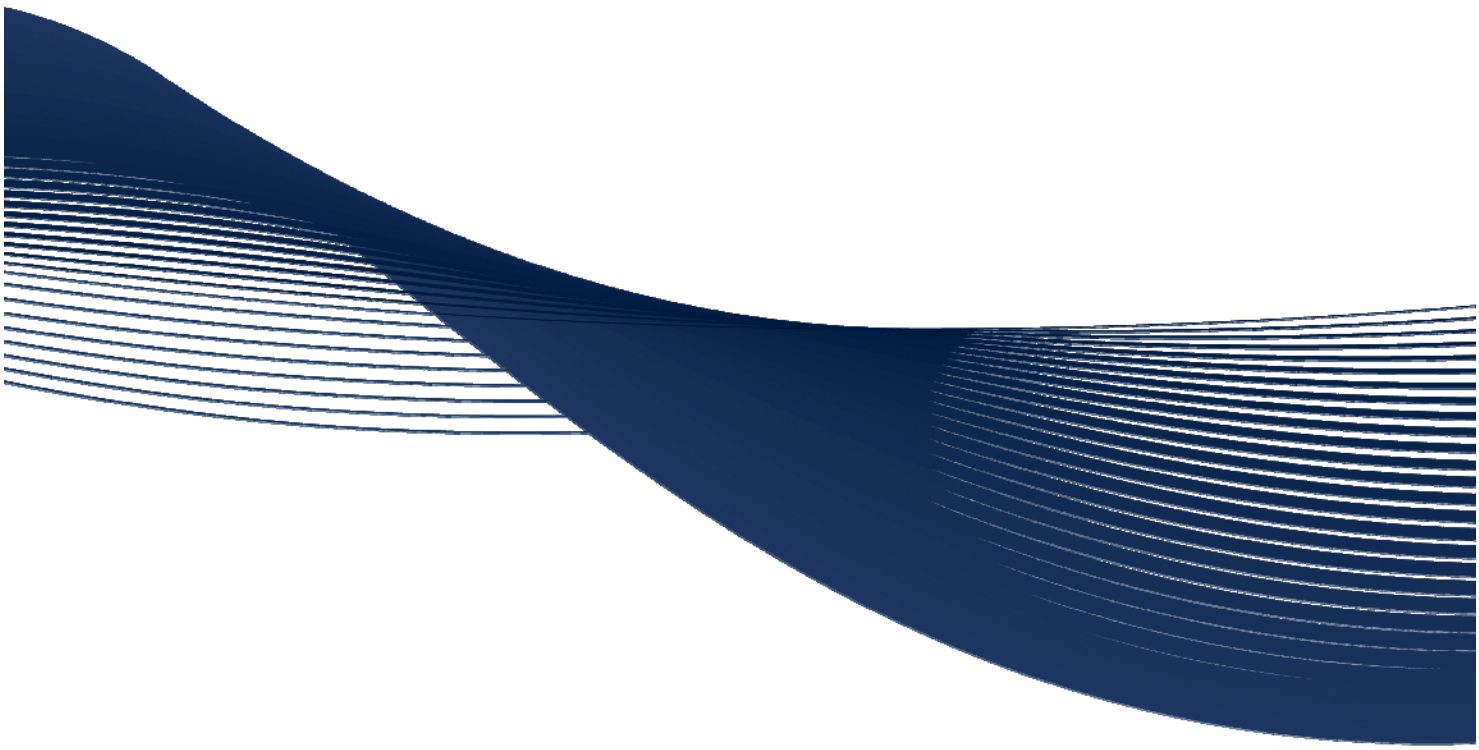
APPENDIX J
STORMWATER MANAGEMENT REPORT

Town of Oakville

Stormwater Management Report

□a□□i□□□ □ar□lll Mid□□wn □□□□□wn □□□a□□i□□□

□r□□□□□□ □□□□□□□□□□



COLE ENGINEERING

□□□□ □□□□□

COLE ENGINEERING GROUP LTD.

□□□D □□□I□□
□□ □a□□□w□□d Dri□□
Mar□□a□ □□□ □ □□□□D□ □□R □□5
T. □□5□□□□□□□□□□ □□□□□□□□□□□□□□
F. □□5□□□□□□□□□□ □www□□ □□□□ngin□□ring□□a

G□□ W□□□ □□□I□□
□5□ □□□r□n□□□ar□ Dri□□ W□□□□□□ni□□ □□□□
Mi□□i□□a□ga□□ □ □□□□D□ □5W □□□
T. □□5□□□□□□□□□□
F. □□5□□□□□□□□□□

1.0 Introduction

Cole Engineering Group Ltd. (Cole Engineering) was retained by the Town of Oakville (the town) in 2012, following completion of the town's Transportation Master Plan (TMP) to complete a Class Environmental Assessment (EA) Study for improvements to Midtown Oakville. As part of this EA Study, a preferred alternative of transportation improvements was selected. The purpose of this Stormwater Management (SWM) Report is to assess the hydrologic and hydraulic impacts of the preferred alternative.

1.1. Site Description

Midtown Oakville, which is approximately 100 ha in size, has been identified as a vibrant, transit-supportive, mixed-use urban community. It will accommodate a significant portion of the future population growth and employment in the Greater Golden Horseshoe. As part of this future growth in population and employment within Midtown Oakville, transportation improvements were proposed as part of the Midtown Oakville EA Study. Throughout the EA process, several alternatives for transportation improvements were evaluated, and a preferred alternative was selected. The preferred alternative includes the proposed Trafalgar Road Interchange and the Royal Windsor Drive Interchange. The road layout of the preferred alternative is shown on **Figure DAP-2** provided at the end of this report.

1.2. Report Purpose

As part of the Midtown Oakville EA Study, the hydrologic and hydraulic impacts of the alternatives were assessed qualitatively. The purpose of this report is to discuss the hydrologic and hydraulic impacts of the preferred alternative and to advise on preliminary watercourse crossing requirements for the proposed transportation improvements within the study area. Preliminary SWM criteria are recommended as part of this Class EA, with a predominant focus on setting peak flow targets for each of the subwatersheds within the Midtown Oakville study area, and a preliminary assessment of water quality, erosion control and water balance.

1.3. Background Review

As noted in the *Stormwater Management Phase 1 Analysis Report* prepared by Cole Engineering, dated August 2012, the following background information was reviewed in order to identify the existing conditions within the Midtown Oakville study area:

- Town of Oakville Development Engineering Procedures and Guidelines Manual by the Town of Oakville (2013);
- Drainage and Hydrology Report Queen Elizabeth Way Widening & Improvements from East of Third Line to 1 km East of Trafalgar Road by URS (2006);
- Queen Elizabeth Way Widening & Improvements from East of Third Line to 1 km East of Trafalgar Road ESR by URS (2004);
- Queen Elizabeth Way from East of Third Line to East of Trafalgar Road Transportation ESR Addendum by McCormick Rankin Corporation/Ecoplans Limited (2006);
- Excerpts from 2010 Creek Erosion Inventory and Assessment Study by AECOM (2010);

- Lower Morrison/Wedgewood Creeks Flood Erosion and Master Drainage Plan Study Technical Report by R.V. Anderson Associates Limited (1993);
- Mid Town Core Drainage Study figure by SPNR Consultants Inc.;
- Town-wide Flood Study Town of Oakville by Philips Engineering Ltd. (2008);
- GIS data including storm sewers, catchbasins, storm sewer manholes, inlet/outlet structures, 1 m contours, watercourses, parcels, roads, right of ways, railways, and buildings; and,
- Plan and profiles for roads throughout the majority of the study area.

1.4. Site Visit

A site walk was completed with Conservation Halton on August 23, 2012 in order to identify any concerns or constraints with regards to stormwater management. The detailed notes from this site visit are provided in **Appendix A** of this report. The site walk included seven (7) locations of concern within the Midtown Oakville study area. The locations visited as part of the site walk are as follows:

- Site 1- Crossing of 16 Mile Creek at the Q.E.W.;
- Site 3 - South Service Road East at open watercourse;
- Site 4 - Wetland;
- Site 9 - Crossing of rail tracks west of Chartwell Road;
- Site 10 - South Service Road East west of Chartwell Road;
- Site 11 – High Priority Flooding Site at South Service Road East between Royal Windsor Drive and CNR; and
- Site 12 – Diversion Channel

Subsequent to this site visit, as well as the Technical Agencies Committee (TAC) Meeting #1 on July 17, 2012, preliminary comments (dated October 10, 2012) were received from Conservation Halton. These comments are also provided in **Appendix A**. As noted by Conservation Halton, at a minimum the proposed alternative must have no negative impacts on flooding and erosion hazards, and any opportunities to improve any deificiencies with respect to flooding and erosion should also be investigated. Conservation Halton has indicated areas of concern with regards to flooding and erosion impacts as part of these comments.

2.0 Hydrology

2.1. Existing Conditions

2.1.1. Drainage Catchment Delineation

Major drainage areas within the Midtown Oakville study area were determined using 1 m contour data provided by the town. These drainage areas were compared against those shown in the *Lower Morrison/Wedgewood Creeks Flood, Erosion and Master Drainage Plan Study Technical Report* prepared by R.V. Anderson Associates Limited (1993). The drainage catchments shown in the *Lower Morrison/Wedgewood Creeks Flood, Erosion and Master Drainage Plan Study Technical Report* were confirmed to show similar drainage patterns to those determined using the 1 m contour data. The

drainage areas were further refined based on plan and profile information received from the town for roads and highways within the study area. The existing drainage area plan is shown on **Figure DAP-1** provided at the end of this report. As indicated on **Figure DAP-1**, the drainage catchments within the Midtown Oakville study area contribute flow to the following four (4) watercourses:

- Lower Morrison Creek;
- Wedgewood Creek;
- Morrison/Wedgewood Diversion Channel; and
- 16 Mile Creek

2.1.2. Weighted Imperviousness

The existing drainage conditions were simulated using a Visual OTTHYMO (VO2) hydrology model. A weighted imperviousness was determined in GIS for each drainage catchment based on land use shapefiles received from the town. A total imperviousness was assumed for each land use type based on the runoff coefficient values provided in the Town of Oakville's *Development Engineering Procedures and Guidelines*, for which an excerpt from this document regarding runoff coefficients is provided in **Appendix B**. The runoff coefficient values were then converted to percent imperviousness values by using the following conversion equation:

$$\% \text{ imp} = (C - 0.20) / (0.95 - 0.20)$$

Where:

% imp = imperviousness (%)
C = runoff coefficient

A summary of the imperviousness for each land use type within the Midtown Oakville study area is provided in **Table 2-1**. It is noted in **Table 2-1** that runoff coefficients for the Road and Railway land use types were not provided in the Town of Oakville's *Development Engineering Procedures & Guidelines*. Therefore, an imperviousness of 90% was assumed for both of these land use types, as they are shown as predominantly impervious from aerial images.

Table 2-1 – Land Use Type Imperviousness

Land Use Type (from Town GIS data)	Land Use Category (from Oakville Development Standards)	Runoff Coefficient (from Oakville Development Standards)	Correlated Imperviousness (%)
Business Commercial	Industrial/Commercial	0.90	93
Business Employment	Industrial/Commercial	0.90	93
Community Commercial	Industrial/Commercial	0.90	93
Core Commercial	Industrial/Commercial	0.90	93
High Density Residential	High Density (Condo/Highrise)	0.80	80
Industrial	Industrial/Commercial	0.90	93
Institutional	Industrial/Commercial	0.90	93
Low Density Residential	Single Residential	0.60	53
Low Density Residential – Special Policy	Single Residential	0.60	53
Medium Density Residential	Medium Density (Townhouses)	0.70	67
Natural Area**	N/A	0.20	0
Neighbourhood Commercial	Industrial/Commercial	0.90	93
Office Employment	Industrial/Commercial	0.90	93
Parks and Open Space**	N/A	0.20	0
Road*	N/A	N/A	90
Railway*	N/A	N/A	90
Urban Centre	Industrial/Commercial	0.90	93
Urban Core	Industrial/Commercial	0.90	93

**Note: values not provided for these land use types in the town's development standards – imperviousness assumed based on aerial images*

***Note: values not provided for these land use types in the town's development standards – imperviousness assumed at 0% since land use is undeveloped and pervious*

The weighted imperviousness for each catchment was calculated by determining the fraction of each land use type applied at the imperviousness values provided in **Table 2-1**. Any drainage catchment with a total imperviousness greater than 25% was simulated as a STANDHYD command in the VO2 model, and any catchment with a total imperviousness less than 25% was simulated as a NASHYD command. The weighted imperviousness for each drainage catchment is summarized in **Table 2-2**, for which the detailed calculations are provided in **Appendix B**.

Table 2-2 – Weighted Imperviousness

Catchment ID	Drainage Area (ha)	Total Imperviousness (%)	VO2 Command
A1	9.72	46	STANDHYD
A2	2.18	39	STANDHYD
A3	8.96	46	STANDHYD
A4	11.16	86	STANDHYD
A5	14.86	93	STANDHYD
A6	34.81	90	STANDHYD
A7	19.31	89	STANDHYD
A8	5.73	50	STANDHYD
A9	42.85	68	STANDHYD
A10	7.93	53	STANDHYD
A11	18.74	93	STANDHYD
A12	1.17	93	STANDHYD
A13	29.43	80	STANDHYD
A14	1.88	56	STANDHYD
A15	2.31	13	NASHYD
A16	11.25	93	STANDHYD
A17	9.75	52	STANDHYD
A18	11.58	53	STANDHYD
A19	1.83	14	NASHYD
A20	69.17	86	STANDHYD
A21	4.49	92	STANDHYD
A22	13.54	53	STANDHYD
A23	4.36	78	STANDHYD
A24	2.54	93	STANDHYD
A25	5.77	53	STANDHYD
A26	4.46	92	STANDHYD
A27	4.22	62	STANDHYD
A28	14.88	90	STANDHYD
A29	37.35	73	STANDHYD
A30	9.95	66	STANDHYD
A31	4.99	53	STANDHYD

It is noted that for all STANDHYD commands, it was assumed that all impervious areas are directly connected. This is a conservative assumption, however, it is anticipated that most roofs are connected as land use is predominantly commercial/industrial and urban roadways.

2.1.3. Weighted CN Values

A weighted CN value was also determined in GIS for each drainage catchment based on land use shapefiles received from the town, as well as the soil type information from the Ontario Soils Map of Halton County. From the soils mapping it was determined that the study area is comprised of three (3) soil types: clay loam, sandy loam and loam over bedrock. These soil types were classified into soil groups as per MTO Design Chart 1.08, which is provided in **Appendix B**. These soil groups were then applied to the land use types in MTO Design Chart 1.09 (also provided in **Appendix B**) in order to determine the resulting CN values (AMC II). The soil types, soil groups, land use and CN values are summarized in **Table 2-3**.

Table 2-3 – CN Values

Soil Type	Soil Group (from MTO Design Chart 1.08)	Land Use (from MTO Design Chart 1.09)	CN Value (AMC II) from MTO Design Chart 1.09
Sandy Loam	AB	Crop and Other Improved Land	70
Loam Overlying Bedrock	B		74
Clay Loam	C		82
		Woodlots and Forest	71
		Pasture and Other Unimproved Land	76

The weighted CN value for each catchment was calculated by determining the fraction of each CN area applied at the values provided in **Table 2-3**. For the STANDHYD commands in the VO2 model, the weighted CN values were applied to the Rainfall Loss – Modified SCS Curve Method. However, for the NASHYD commands in the VO2 model, the weighted CN values are applied to the pervious fraction only of the NASHYD catchments. The impervious fraction of the NASHYD catchments were designated a CN value of 98, as per MTO Design Chart 1.09. A composite CN value was then determined based on the pervious and impervious fractions of the NASHYD catchments. The weighted CN values for each drainage catchment are summarized in **Table 2-4**, for which the detailed calculations are provided in **Appendix B**.

Table 2-4 – Weighted CN Values

Catchment ID	Drainage Area (ha)	Weighted CN Value for Rainfall Loss Method in STANDHYDS (AMC II)	Pro-Rated for Impervious Area in NASHYD commands (AMC II)	Weighted CN Value for Rainfall Loss Method in STANDHYDS (AMC III)	Pro-Rated for Impervious Area in NASHYD commands (AMC III)
A1	9.72	81	-	91	-
A2	2.18	80	-	91	-
A3	8.96	79	-	90	-
A4	11.16	82	-	92	-
A5	14.86	82	-	92	-
A6	34.81	82	-	92	-
A7	19.31	82	-	92	-
A8	5.73	81	-	91	-
A9	42.85	81	-	91	-
A10	7.93	82	-	92	-
A11	18.74	82	-	92	-
A12	1.17	82	-	92	-
A13	29.43	82	-	92	-
A14	1.88	82	-	92	-
A15	2.31	-	80	-	91
A16	11.25	82	-	92	-
A17	9.75	81	-	91	-
A18	11.58	77	-	89	-
A19	1.83	-	78	-	90
A20	69.17	81	-	91	-
A21	4.49	82	-	92	-
A22	13.54	82	-	92	-
A23	4.36	81	-	91	-
A24	2.54	82	-	92	-
A25	5.77	81	-	91	-
A26	4.46	82	-	92	-
A27	4.22	76	-	89	-
A28	14.88	82	-	92	-
A29	37.35	81	-	91	-
A30	9.95	81	-	91	-
A31	4.99	80	-	91	-

2.1.4. Existing Conditions Hydrology Model

The existing conditions NASHYD and STANDHYD model input parameters are provided in **Appendix B**. The existing drainage conditions were modeled in VO2 using the 24-hour Chicago storm distribution, as per the town's design criteria. The Regional storm was also simulated in VO2 for existing conditions. In order to simulate existing conditions for the Regional storm event, the AMC II CN values were converted to AMC III CN values, as shown in **Table 2-4**. The input parameters for the existing conditions Regional storm model are provided in **Appendix B**. The existing flows were evaluated for the four (4) watercourses noted in **Section 2.1.1**. The results from the existing conditions hydrology model are summarized in **Table 2-5**, for which the detailed model output is provided in **Appendix B**.

Table 2-5 – Existing Conditions Flow Results (24-hr Chicago)

Storm Event	Total Flow to Lower Morrison Creek (m^3/s) Total Area = 197.75 ha	Total Flow to Wedgewood Creek (m^3/s) Total Area = 107.55 ha	Total Flow to Morrison/Wedgewood Diversion Channel (m^3/s) Total Area = 42.85 ha	Total Flow to 16 Mile Creek (m^3/s) Total Area = 73.02 ha
2-Year	29.09	14.97	4.87	11.35
5-Year	42.99	22.17	8.19	16.56
10-Year	52.12	29.67	9.96	19.97
25-Year	64.91	37.13	12.37	24.65
50-Year	74.26	42.44	14.90	28.17
100-Year	83.98	47.49	16.76	31.69
Regional	28.85	15.72	6.19	10.67

2.2. Target Flows

As per the *Lower Morrison/Wedgewood Creeks – Flood, Erosion and Master Drainage Plan Study*, prepared by R.V. Anderson Associates Ltd. (January 1993), peak runoff rates from all new developments within the Lower Morrison Creek and Wedgewood Creek watersheds are to be controlled to 50% of pre-development levels in order to mitigate potential erosion and flooding. The existing flows for Lower Morrison Creek and Wedgewood Creek from **Table 2-5**, were applied at 50% and compared to the existing flows provided in Table 3-11 of the *Lower Morrison/Wedgewood Creeks – Flood, Erosion and Master Drainage Plan Study*. This flow comparison is summarized in **Table 2-6**. As noted in **Table 2-6**, the existing Wedgewood Creek flows applied at 50% are well below the existing flows from the *Lower Morrison/Wedgewood Creeks – Flood, Erosion and Master Drainage Plan Study*, however, the existing Lower Morrison Creek flows applied at 50% are above the existing flows from the *Lower Morrison/Wedgewood Creeks – Flood, Erosion and Master Drainage Plan Study*. The existing flows from the VO2 model are significantly higher than the existing flows from the R.V. Anderson creek study as a result of assuming much higher imperviousness values. The target flows for the Wedgewood Creek will remain at 50% of existing flows, as per the R.V. Anderson study, but the existing flows from Table 3-11 of the R.V. Anderson creek study will be applied as the target flows for Lower Morrison Creek.

Table 2-6 – Flow Comparison with R.V. Anderson Lower Morrison/Wedgewood Creek Study (1993)

Storm Event	Lower Morrison Creek – 50% Existing Flows from Table 2-5 (m^3/s)	Lower Morrison Creek – Existing Flows from Table 3-11 in R.V. Anderson Study at Morrison Road (m^3/s)	Wedgewood Creek – 50% Existing Flows from Table 2-5 (m^3/s)	Wedgewood Creek – Existing Flows from Table 3-11 in R.V. Anderson Study at Alscot Crescent (m^3/s)
2-Year	14.6	11.2	7.5	10.6
5-Year	21.5	14.6	11.1	13.6
10-Year	26.1	18.2	14.8	17.0
25-Year	32.5	23.5	18.6	21.9
50-Year	37.1	27.4	21.2	25.8
100-Year	42.0	31.5	23.8	30.1

It is indicated in the *Morrison/Wedgewood Diversion Channel – Spill Control Class Environmental Assessment*, prepared by AMEC Environment & Infrastructure (May 2012), that there is a current potential for a spill of flood waters during extreme storm conditions, which potentially affects those lands within the vicinity of the diversion channel, as well as properties further downstream. However, work is currently being undertaken on behalf of Conservation Halton in order to mitigate these flood impacts of the diversion channel. Therefore, as part of the SWM analysis for the Midtown Oakville study area, it is recommended that peak runoff rates from any future development within the Morrison/Wedgewood Diversion Channel watershed be controlled to existing conditions. As there are no existing flood concerns for 16 Mile Creek in the study area, peak runoff rates from all future developments within the 16 Mile Creek watershed are also to be controlled to existing conditions. The target flows for the four (4) watersheds are summarized in **Table 2-7**. These targets are only applied for the 2-year to 100-year storm events.

Table 2-7 – Target Flows (24-hr Chicago)

Storm Event	Target Flow at Lower Morrison Creek (m^3/s) Total Area = 197.75 ha	Target Flow at Wedgewood Creek (m^3/s) Total Area = 107.55 ha	Target Flow at Morrison/Wedgewood Diversion Channel (m^3/s) Total Area = 42.85 ha	Target Flow at 16 Mile Creek (m^3/s) Total Area = 73.02 ha
2-Year	11.2	7.5	4.9	11.4
5-Year	14.6	11.1	8.2	16.6
10-Year	18.2	14.8	10.0	20.0
25-Year	23.5	18.6	12.4	24.7
50-Year	27.4	21.2	14.9	28.2
100-Year	31.5	23.8	16.8	31.7

2.3. Proposed Conditions – Preferred Alternative

As a result of the proposed transportation improvements, the existing drainage conditions will be modified. The proposed drainage conditions resulting from the transportation improvements are shown on **Figure DAP-2**, provided at the end of this report. As noted in **Figure DAP-2**, the proposed transportation improvements result in minor modifications to the drainage patterns within some of the catchments, however, the overall existing drainage patterns are maintained within the study area. The proposed Trafalgar Road Interchange and Royal Windsor Drive Interchange result in an overall increase to the total imperviousness of several drainage catchments, as the average imperviousness of these proposed roads is approximately 90%. With regards to drainage delineation, several catchments are affected by the proposed conditions resulting from the transportation improvements, as shown on **Figure DAP-2**. Similar to the analysis done for existing conditions, the proposed conditions of the transportation improvements was modeled using VO2. Due to the increase in imperviousness of several drainage catchments under proposed conditions, the resulting flows to the four (4) watercourses will increase with no mitigation measures. In order to mitigate these increases in flow under the proposed conditions of the transportation improvements, a total storage requirement was determined for each of the four (4) subwatershed blocks within the study area. This storage requirement is to be applied as a quantity control criteria on a per unit basis (m^3/ha) for any future development within each of the four (4) blocks, which is discussed in further detail in **Section 2.5.1**.

2.3.1. Weighted Imperviousness

In order to determine the weighted imperviousness of each drainage catchment under proposed conditions, the same process was used as discussed in **Section 2.1.1**. The weighted imperviousness for each drainage catchment is summarized in **Table 2-8**, for which the detailed calculations are provided in **Appendix C**.

Table 2-8 – Weighted Imperviousness

Catchment ID	Drainage Area (ha)	Total Imperviousness (%)	VO2 Command
A1	9.72	46	STANDHYD
A2	2.18	39	STANDHYD
A3	8.96	46	STANDHYD
A4	11.16	86	STANDHYD
A5	14.33	93	STANDHYD
A6	34.81	89	STANDHYD
A7-a	9.32	88	STANDHYD
A7-b	9.98	90	STANDHYD
A8	5.73	50	STANDHYD
A9	42.85	68	STANDHYD
A10	7.93	53	STANDHYD
A11	19.25	92	STANDHYD
A12	1.17	91	STANDHYD
A13	29.43	82	STANDHYD

Table 2-8 – Weighted Imperviousness (Continued)

Catchment ID	Drainage Area (ha)	Total Imperviousness (%)	VO2 Command
A14	1.88	56	STANDHYD
A15	2.31	13	NASHYD
A16	11.78	92	STANDHYD
A17	9.75	52	STANDHYD
A18	11.58	53	STANDHYD
A19	1.83	14	NASHYD
A20	69.17	89	STANDHYD
A21	4.49	92	STANDHYD
A22	13.54	53	STANDHYD
A23	4.36	78	STANDHYD
A24	2.54	93	STANDHYD
A25	5.77	53	STANDHYD
A26	4.46	92	STANDHYD
A27	4.22	62	STANDHYD
A28-a	6.40	93	STANDHYD
A28-b	7.97	88	STANDHYD
A29	37.35	72	STANDHYD
A30	9.95	66	STANDHYD
A31	4.99	53	STANDHYD

As with existing conditions, all impervious area in each STANDHYD command was assumed to be directly connected.

2.3.2. Weighted CN Values

In order to determine the weighted CN value of each drainage catchment under proposed conditions, the same process was used as discussed in **Section 2.1.2**. The weighted CN value (AMC II) for each drainage catchment is summarized in **Table 2-9**, for which the detailed calculations are provided in **Appendix C**.

Table 2-9 – Weighted CN Values

Catchment ID	Drainage Area (ha)	Weighted CN Value for Rainfall Loss Method in STANDHYDS (AMC II)	Pro-Rated for Impervious Area in NASHYD commands (AMC II)	Weighted CN Value for Rainfall Loss Method in STANDHYDS (AMC III)	Pro-Rated for Impervious Area in NASHYD commands (AMC III)
A1	9.72	81	-	91	-
A2	2.18	80	-	91	-
A3	8.96	79	-	90	-
A4	11.16	82	-	92	-
A5	14.33	82	-	92	-
A6	34.81	82	-	92	-
A7-a	9.32	82	-	92	-
A7-b	9.98	82	-	92	-
A8	5.73	81	-	91	-
A9	42.85	81	-	91	-
A10	7.93	82	-	92	-
A11	19.25	82	-	92	-
A12	1.17	82	-	92	-
A13	29.43	82	-	92	-
A14	1.88	82	-	92	-
A15	2.31	-	80	-	91
A16	11.78	82	-	92	-
A17	9.75	81	-	91	-
A18	11.58	77	-	89	-
A19	1.83	-	78	-	90
A20	69.17	82	-	92	-
A21	4.49	82	-	92	-
A22	13.54	82	-	92	-
A23	4.36	81	-	91	-
A24	2.54	82	-	92	-
A25	5.77	81	-	91	-
A26	4.46	82	-	92	-
A27	4.22	76	-	89	-
A28-a	6.40	82	-	92	-
A28-b	7.97	82	-	92	-
A29	37.35	81	-	91	-
A30	9.95	81	-	91	-
A31	4.99	80	-	91	-

2.3.3. Proposed Conditions Hydrology Model

The proposed conditions NASHYD and STANDHYD model input parameters are provided in **Appendix C**. Similar to the existing conditions model, the proposed drainage conditions were modeled in VO2 using the 24-hour Chicago storm distribution, as per the town's design criteria. The Regional storm was also simulated in VO2 for proposed conditions. In order to simulate proposed conditions for the Regional storm event, the AMC II CN values were converted to AMC III CN values, as shown in **Table 2-8**. The input parameters for the proposed conditions Regional storm model are provided in **Appendix C**. However, the Regional storm event was not evaluated for storage requirements, as the 100-year storm is the governing storm event. This is shown in **Table 2-5** which indicates that the Regional storm is less than the 5-year storm event for existing conditions. Detailed output for the proposed conditions Regional storm model can be provided upon request.

The proposed conditions VO2 model was used to determine the storage required for each of the four (4) subwatershed blocks to meet the target flows summarized in **Table 2-6**. A summary of the proposed conditions flows and storage requirements is provided in **Tables 2-10** to **2-13**, for which the detailed model output is provided in **Appendix C**.

Table 2-10 – Proposed Conditions Flow Results (24-hr Chicago): Lower Morrison Creek

Storm Event	Target Flow from Table 2-7 (m^3/s)	Total Post-Development Flow Uncontrolled (m^3/s)	% Increase in Flow over Target Without Controls	Total Storage Required (m^3)
2-Year	11.2	29.2	+161%	20,777
5-Year	14.6	43.1	+195%	30,936
10-Year	18.2	52.3	+187%	37,229
25-Year	23.5	65.1	+177%	45,011
50-Year	27.4	74.4	+172%	50,376
100-Year	31.5	84.2	+167%	55,552

Table 2-11 – Proposed Conditions Flow Results (24-hr Chicago): Wedgewood Creek

Storm Event	Target Flow from Table 2-7 (m^3/s)	Total Post-Development Flow Uncontrolled (m^3/s)	% Increase in Flow over Target Without Controls	Total Storage Required (m^3)
2-Year	7.5	15.3	+104%	11,345
5-Year	11.1	22.6	+104%	15,984
10-Year	14.8	30.6	+107%	18,604
25-Year	18.6	37.8	+103%	22,032
50-Year	21.2	43.2	+104%	24,486
100-Year	23.8	48.3	+103%	26,934

Table 2-12 – Proposed Conditions Flow Results (24-hr Chicago): Morrison/Wedgewood Diversion Channel

Storm Event	Target Flow from Table 2-7 (m^3/s)	Total Post-Development Flow Uncontrolled (m^3/s)	% Increase in Flow over Target Without Controls	Total Storage Required (m^3)
2-Year	4.9	4.9	+0%	0
5-Year	8.2	8.2	+0%	0
10-Year	10.0	10.0	+0%	0
25-Year	12.4	12.4	+0%	0
50-Year	14.9	14.9	+0%	0
100-Year	16.8	16.8	+0%	0

Table 2-13 – Proposed Conditions Flow Results (24-hr Chicago): 16 Mile Creek

Storm Event	Target Flow from Table 2-7 (m^3/s)	Total Post-Development Flow Uncontrolled (m^3/s)	% Increase in Flow over Target Without Controls	Total Storage Required (m^3)
2-Year	11.4	11.5	+0.9%	1791
5-Year	16.6	16.7	+0.6%	2610
10-Year	20.0	20.1	+0.5%	3146
25-Year	24.7	24.8	+0.4%	3878
50-Year	28.2	28.3	+0.4%	4425
100-Year	31.7	31.9	+0.3%	4980

2.4. Flow Diversion

As per the *Lower Morrison/Wedgewood Creeks – Flood, Erosion and Master Drainage Plan Study*, prepared by R.V. Anderson Associates Ltd. (January 1993), there are currently major flooding and erosion issues within the Lower Morrison and Wedgewood Creeks. Therefore, in addition to applying the target flows specified in **Section 2.2** of this report, options were analyzed to divert flow from the Lower Morrison Creek watershed to the 16 Mile Creek watershed. This diversion was assessed at a high level in order to determine feasibility and the benefits to decreasing flows in Lower Morrison Creek. This assessment consisted of a hydrologic review only, and if this diversion is to be considered futher, the resulting impacts to ecology and base flows should be assessed under separate cover.

The hydrologic assessment indicated that it is possible that the minor (5-year) flows from catchments A-4, A-29, A-17 and A-22 from the Lower Morrison Creek watershed (as shown in **Figure DAP-2**) be diverted via a storm pipe along the proposed Cross Avenue road. The minor flow from catchment A-4 could be captured at the following three (3) low points:

- Proposed underpass at Trafalgar Road;

- Proposed intersection of Cross Avenue at Trafalgar Road; and
- The southeast corner of catchment A-4

The minor flow from catchments A-29, A-17 and A-22 are to be diverted from the existing 1800 mm ø pipe at Argus Road and Trafalgar road, and conveyed to the proposed diversion pipe along Cross Avenue.

The proposed diversion pipe would also convey flows captured at the proposed Cross Avenue road from the north portions of catchments A-28 and A-11 within the 16 Mile Creek watershed, and therefore the proposed diversion pipe would be sized to convey these flows as well. As per the Town of Oakville design standards, the obvert of any outlet to a watercourse must be above the 25-year water level. As per the HEC-RAS model of 16 Mile Creek provided by Conservation Halton, the 25-year water level at the location of the proposed outlet (Section 3299.205) is 79.61 m. The obvert of the proposed diversion pipe must remain above this water level. The proposed diversion pipe is assumed to be 869 m in length at 1.0%. The layout of the proposed diversion pipe is shown on **Figure DIV-1**.

As the proposed Cross Avenue road slopes in an easterly direction towards Trafalgar Road at approximately 0.5%, it will not be possible to convey major flows from the diverted catchments along the proposed road to 16 Mile Creek. The flows to the proposed diversion pipe were determined using the Rational Method, for which the calculations are provided in **Appendix D**. The proposed pipe was sized using FlowMaster, for which the model output is also provided in **Appendix D**. As indicated in the FlowMaster model output, the diversion pipe is required to be a minimum of 2400 mm ø in order to adequately convey the 5-year flow. **Table 2-14** summarizes the various parameters for the proposed diversion pipe required to convey the 5-year storm event. As per **Table 2-14**, the diversion pipe was sized to convey 21.4 m^3/s.

Table 2-14 – Diversion Pipe Sizing

Storm Event	Total Flow Diverted from Lower Morrison (m^3/s)	Total Flow to be Conveyed by Diversion Pipe (m^3/s)	Diversion Pipe Diameter (mm)	Upstream Invert (m)	Upstream Obvert (m)	Downstream Invert (m)	Downstream Obvert (m)
5-Year	16.3	21.4	2400	94.30	96.70	85.60	88.00

The hydrologic impacts of diverting this flow from Lower Morrison Creek to 16 Mile Creek were also assessed using VO2. The impacts were assessed for the 24-hour Chicago distribution for the 2-year to the 100-year storm events. The results of the hydrologic analysis are provided in **Tables 2-15** and **2-16**. The VO2 model output for the proposed diversion is provided in **Appendix D**.

Table 2-15 – Proposed Diversion Hydrologic Analysis Results (Lower Morrison Creek)

Storm Event	Target Flow from Table 2-7 (m^3/s)	Total Proposed Flow – No Diversion (m^3/s)	Total Proposed Storage – No Diversion (m^3)	Total Proposed Flow – With Diversion (m^3/s)	Total Proposed Storage – With Diversion (m^3)	Total Change in Storage Resulting From Diversion (m^3)
2-Year	11.2	11.1	20,777	11.0	8794	-11983
5-Year	14.6	14.6	30,936	14.5	13,452	-17,484
10-Year	18.2	18.0	37,229	17.9	17,106	-20,123
25-Year	23.5	23.1	45,011	23.3	22,073	-22,938
50-Year	27.4	26.8	50,376	27.2	26,321	-24,055
100-Year	31.5	30.9	55,552	31.2	30,954	-24,598

Table 2-16 – Proposed Diversion Hydrologic Analysis Results (16 Mile Creek)

Storm Event	Target Flow from Table 2-7 (m^3/s)	Total Proposed Flow – No Diversion (m^3/s)	Total Proposed Storage – No Diversion (m^3)	Total Proposed Flow – With Diversion (m^3/s)	Total Proposed Storage – With Diversion (m^3)	Total Change in Storage Resulting From Diversion (m^3)
2-Year	11.4	10.1	1791	11.2	10,496	+8705
5-Year	16.6	14.8	2610	16.4	15,358	+12,748
10-Year	20.0	17.9	3146	19.6	17,670	+14,524
25-Year	24.7	22.2	3878	23.9	20,323	+16,445
50-Year	28.2	25.4	4425	27.2	21,552	+17,127
100-Year	31.7	28.6	4980	31.5	22,403	+17,423

As shown in **Tables 2-15** and **2-16**, the benefits of the proposed diversion are limited as storage is still required for both Lower Morrison Creek and 16 Mile Creek. With the proposed flow diversion, the storage requirements decrease for Lower Morrison Creek and increase for 16 Mile Creek. Without the proposed flow diversion, the storage requirements decrease for 16 Mile Creek and increase for Lower Morrison Creek. However, the total combined storage requirements for both subwatersheds is not significantly reduced with the proposed diversion. It is therefore not proposed to implement the diversion pipe at this time, but the diversion may be reconsidered in the future. It is recommended that the possibility of the diversion alternative be evaluated as part of the flood opportunities study for Lower Morrison Creek to be conducted by the town in the near future.

2.5. Preliminary SWM Criteria

As part of the SWM assessment for the Midtown Oakville EA Study, the following **Sections 2.5.1** to **2.5.3** provide recommendations on SWM criteria for any future development within Midtown Oakville. The predominant focus of the preliminary SWM criteria recommended as part of this Class EA is on setting flow targets for each of the subwatersheds within the Midtown Oakville study area, with a preliminary assessment of water quality, erosion control and water balance requirements.

2.5.1. Quantity Control

Any future development within the Midtown Oakville study area, including the development of the proposed transportation improvements, is to utilize the Midtown Oakville EA Study hydrology model demonstrating that the target flows previously discussed in **Section 2.2** of this report are met. In addition to meeting the target flows on a block basis, minimum storage is to be provided by any future developments, as discussed in **Section 2.3.3**. The minimum storage requirements are summarized in **Table 2-15**.

Table 2-17 – Unit Storage Requirements for Future Development

Subwatershed Area within Midtown Oakville	Total Storage Required from Tables 2-10 to 2-13 (m^3)	Total Subwatershed Area within Midtown Oakville (ha)	Unit Storage Requirement for Future Development (m^3/ha)
Lower Morrison Creek	55,552	197.75	280.9
Wedgewood Creek	26,934	107.55	250.4
Morrison/Wedgewood Diversion Channel	0	42.85	0
16 Mile Creek	4980	73.02	68.2

In addition to providing the above minimum storage, the Midtown EA hydrologic model must be updated to demonstrate that target flows are achieved. The Regional storm event is also to be modeled in order to determine the downstream impacts of any future development within the Midtown Oakville study area.

2.5.2. Quality Control

Any future development within the Midtown Oakville study area is to achieve Enhanced Level 1 Protection, as per the MOE *Stormwater Management Planning and Design Manual* (March 2003). The proposed road networks as part of the Midtown EA transportation improvements are to be treated with oil/grit separators (OGS) units as a minimum, however, quality treatment of the proposed transportation improvements by low impact development (LID) measures should be considered where feasible.

2.5.3. Water Balance

Any future development within the Midtown Oakville study area shall consider water balance by achieving the greater of either of the two (2) following requirements:

- Provide retention of 5 mm over the entire area of the proposed development, as per the City of Toronto's *Wet Weather Flow Management Guidelines* (November 2006) ; or
- Retain stormwater on-site to achieve an equivalent annual volume of infiltration as pre-development conditions, as per Section 3.2 of the MOE *Stormwater Management Planning and Design Manual* (March 2003).

This water balance can be achieved by a variety of low impact development (LID) measures, as specified in the *Low Impact Development Stormwater Management Planning and Design Guide*, prepared by Credit Valley Conservation and Toronto and Region Conservation Authority (2010). The following LID measures are recommended in the *Low Impact Development Stormwater Management Planning and Design Guide* :

- Rainwater harvesting;
- Green roofs;
- Infiltration trenches and soakaway pits;
- Bioretention;
- Permeable pavement; and
- Perforated pipe systems.

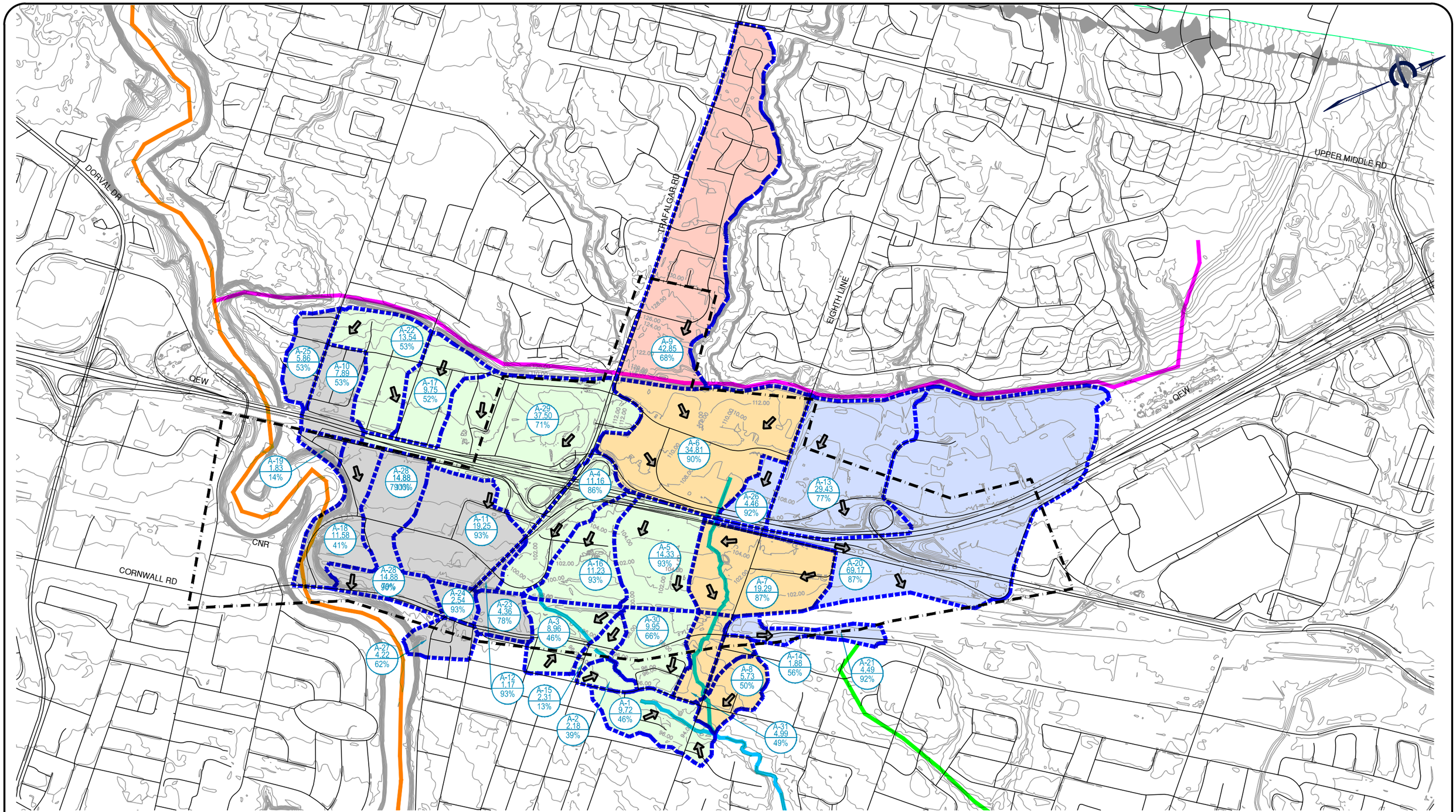
LID measures would be assessed for each development area at the time of re-zoning and/or site plan approval to determine the best method to meet specified targets. The soil types within the Midtown Oakville study area were assessed on a preliminary level in order to determine any locations where infiltration is feasible. The soil types are shown on **Figure LID** provided in **Appendix C**. As noted on **Figure LID**, the study area is predominantly Soil Group C, which provides reasonable infiltration. Therefore, as the predominant soil type throughout the Midtown Oakville study area was determined to provide reasonable infiltration, opportunities for LIDs should be considered for all future developments.

The existing Midtown Oakville area is highly impervious with limited SWM controls, and very limited LID measures. This results in the generation and discharge of runoff during the majority of rainfall events, and would contribute to downstream erosion. Although a SWM criterion for erosion control was not assessed as part of the SWM analysis for this Class EA, from a practical perspective, it is anticipated that the water balance criteria will provide inherent benefits that will ensure that downstream erosion is decreased through development of Midtown Oakville. It should be noted that the town intends to complete a separate flood study in the near future through which there may be opportunity to further assess the SWM criteria for the Midtown Oakville study area in more detail, including potential refinements to erosion and flood control requirements.

3.0 Hydraulics

Hydraulic analysis was completed for the Morrison/Wedgewood Diversion Channel and the Lower Morrison Creek in order to evaluate the hydraulic impacts resulting from the proposed transportation improvements. The hydraulic analysis was completed using a HEC-RAS model for each watercourse. The purpose of the hydraulic analysis is to demonstrate that there are no significant hydraulic impacts (ie. changes in existing water levels) as a result of the proposed transportation improvements. Only the proposed major crossings of these watercourses were analyzed. Any proposed minor crossings and storm conveyance methods (ie. of ditches, swales) will be addressed at detailed design.

As per CH criteria, under all flow conditions, up to and including flows generated by the regulatory storm, the proposed crossings (including all required grading) will not result in any negative impacts to any existing habitable structure, and will provide safe access and egress to adjacent properties and roadways, for the duration or frequency of any spill. Any local water level increases may be accepted provided that:



COLE ENGINEERING
70 VALLEYWOOD DRIVE, MARKHAM, ON L3R 4T5
T:416.987.6161 / 905.940.6161 F:905.940.2064

LEGEND

A-28 14.88 79%
- DRAINAGE NAME
- DRAINAGE AREA (HECTARES)
- IMPERVIOUSNESS

- DRAINAGE TO LOWER MORRISON (RIVER 1)
- DRAINAGE TO LOWER MORRISON (RIVER 2)
- DRAINAGE TO 16 MILE
- DRAINAGE TO WEDGEWOOD MORRISON DIVERSION CHANNEL
- DRAINAGE TO WEDGEWOOD
- LOWER MORRISON CREEK
- 16 MILE CREEK
- WEDGEWOOD CREEK
- MORRISON WEDGEWOOD DIVERSION CHANNEL

227.50 EXISTING CONTOUR LINE

EMERGENCY SPILL / OVERLAND FLOW DIRECTION

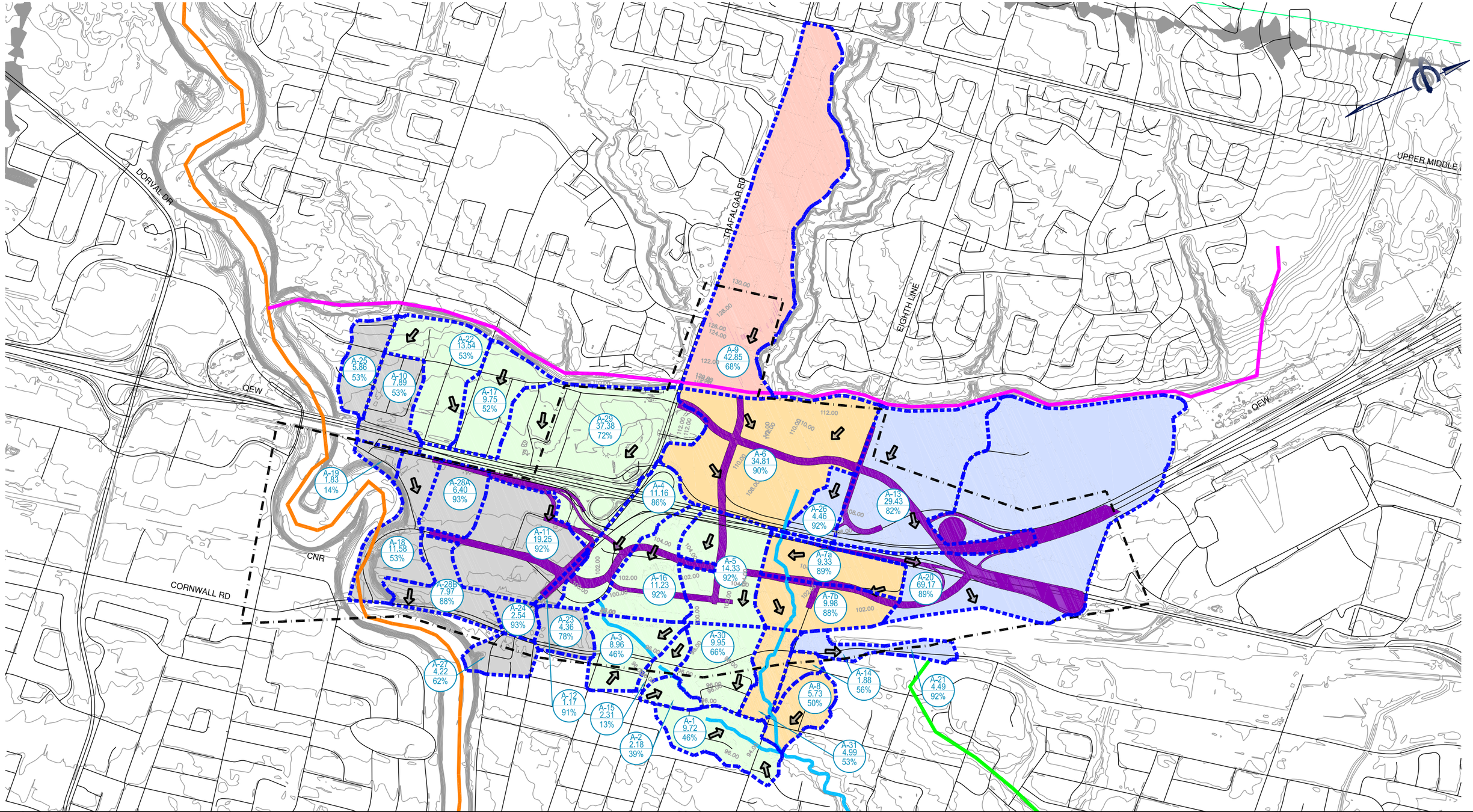
ROADS

STUDY AREA

MAJOR DRAINAGE AREAS (EXISTING CONDITIONS)

MIDTOWN ENVIRONMENTAL ASSESSMENT
TOWN OF OAKVILLE

DATE:	MAY 2014	PROJECT No.:	T11-767
SCALE:	1:15,000	FIGURE No.:	DAP-1



COLE ENGINEERING
70 VALLEYWOOD DRIVE, MARKHAM, ON L3R 4T5
T:416.987.6161 / 905.940.6161 F:905.940.2064

LEGEND

A-28 14.88 79%
- DRAINAGE NAME
- DRAINAGE AREA (HECTARES)
- IMPERVIOUSNESS

- DRAINAGE TO LOWER MORRISON (RIVER 1)
- DRAINAGE TO LOWER MORRISON (RIVER 2)
- DRAINAGE TO 16 MILE
- DRAINAGE TO WEDGEWOOD MORRISON DIVERSION CHANNEL
- DRAINAGE TO WEDGEWOOD
- LOWER MORRISON CREEK
- 16 MILE CREEK
- WEDGEWOOD CREEK
- MORRISON WEDGEWOOD DIVERSION CHANNEL

227.50 EXISTING CONTOUR LINE

EMERGENCY SPILL / OVERLAND FLOW DIRECTION

ROADS

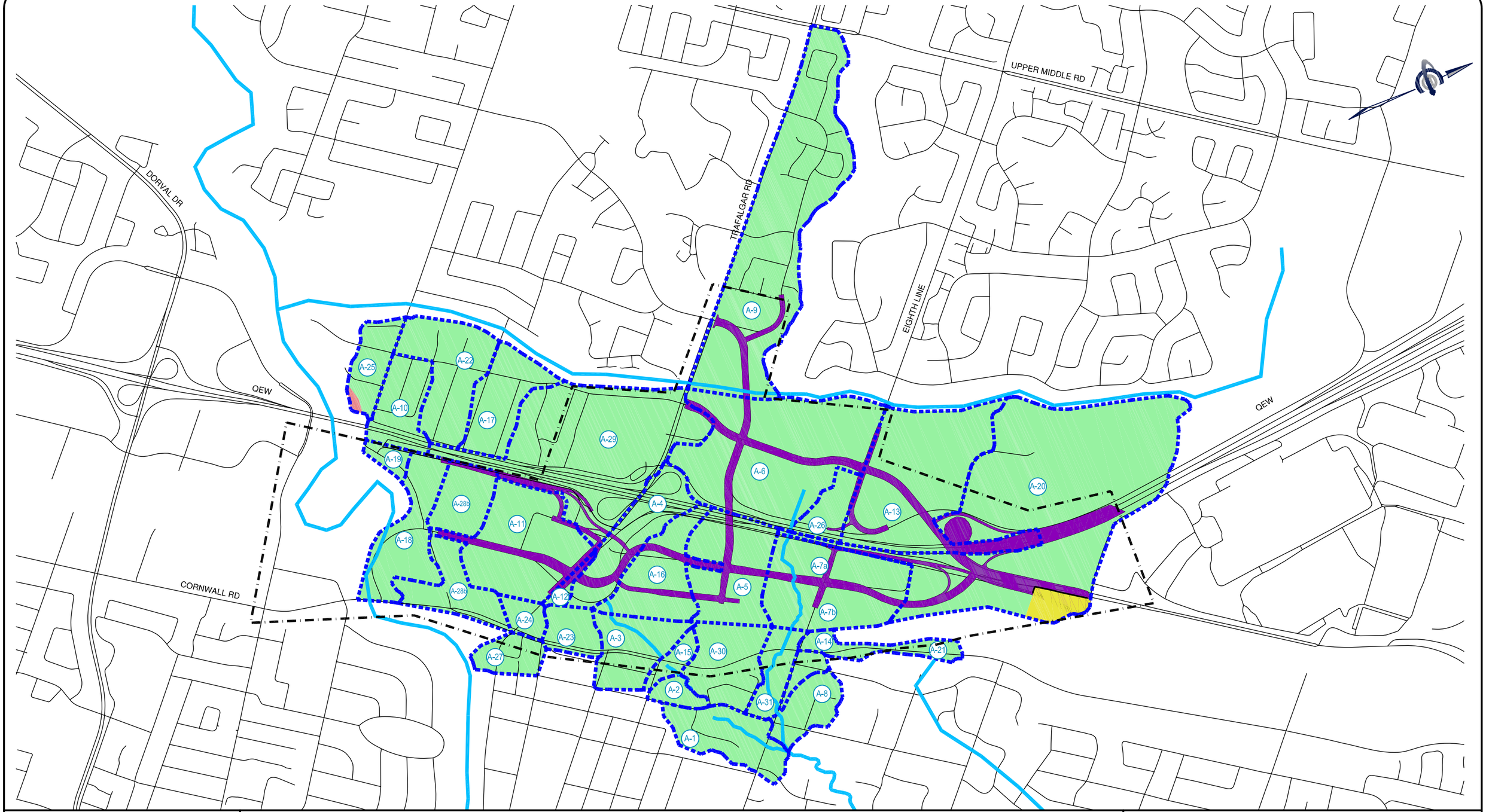
STUDY LIMIT

PROPOSED ROAD

MAJOR DRAINAGE AREAS (PROPOSED CONDITIONS)

MIDTOWN ENVIRONMENTAL ASSESSMENT
TOWN OF OAKVILLE

DATE:	MAY 2014	PROJECT No.:	T11-767
SCALE:	1:15,000	FIGURE No.:	DAP-2



COLE ENGINEERING
70 VALLEYWOOD DRIVE, MARKHAM, ON L3R 4T5
T:416.987.6161 / 905.940.6161 F:905.940.2064

LEGEND

- A-1 DRAINAGE NAME
- EXISTING CREEK
- EXISTING ROADS
- STUDY LIMIT
- SOIL GROUP AB (GOOD INFILTRATION)
- SOIL GROUP B (GOOD INFILTRATION)
- SOIL GROUP C (REASONABLE INFILTRATION)
- PROPOSED ROADS
- DRAINAGE AREA BOUNDARY

POTENTIAL LID AREAS (PROPOSED CONDITIONS)

MIDTOWN ENVIRONMENTAL ASSESSMENT
TOWN OF OAKVILLE

DATE:	MAY 2014	PROJECT No.:	T11-767
SCALE:	1:15,000	FIGURE No.:	LID

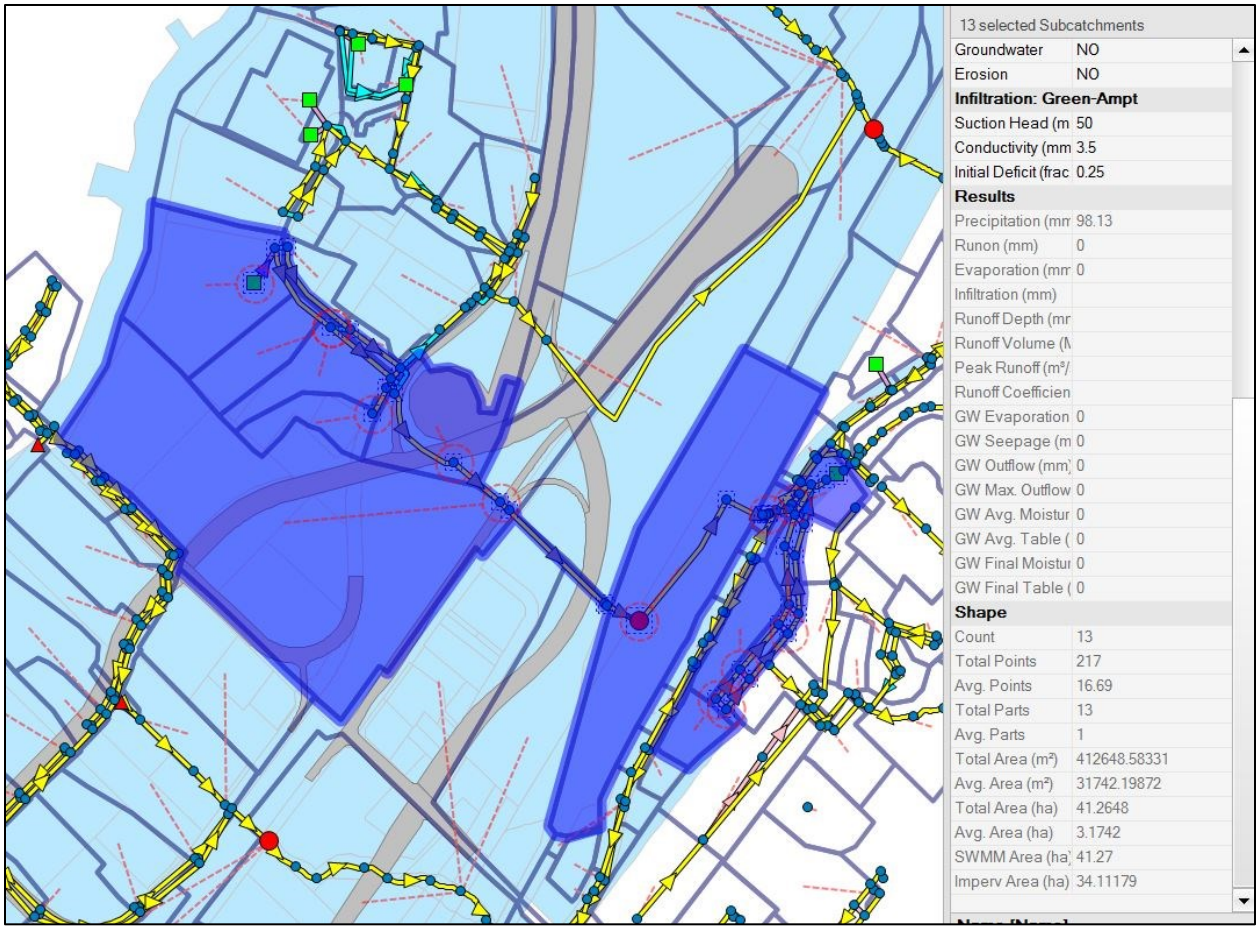


Image 1: Total Drainage area considered for the Lower Wedgewood Creek – West Branch SWM facility.

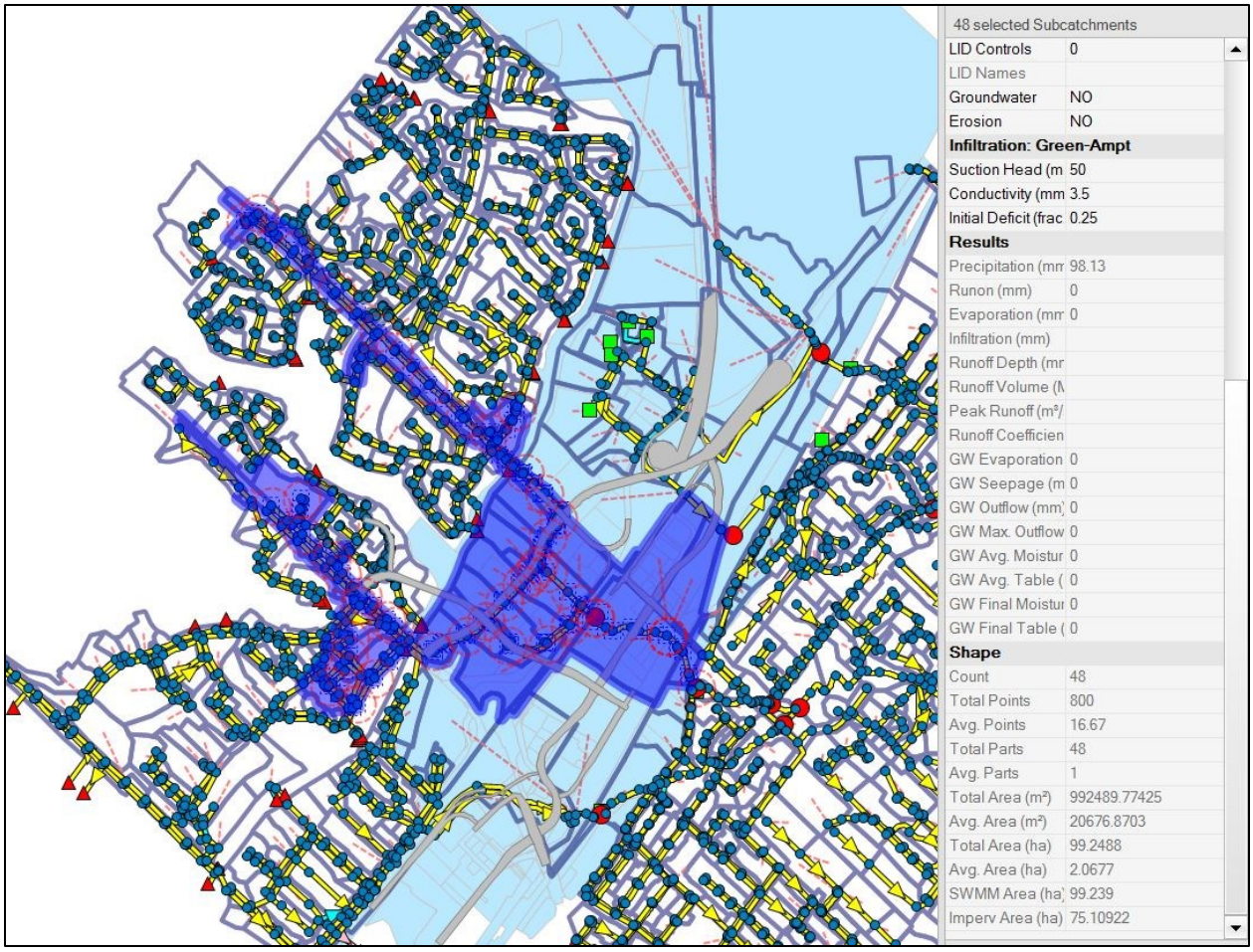


Image 2: Total Drainage area considered for the Lower Morrison Creek – East Branch. Due to Dual drainage network, it also includes drainage area upstream of Morrison-Wedgewood Diversion Channel.

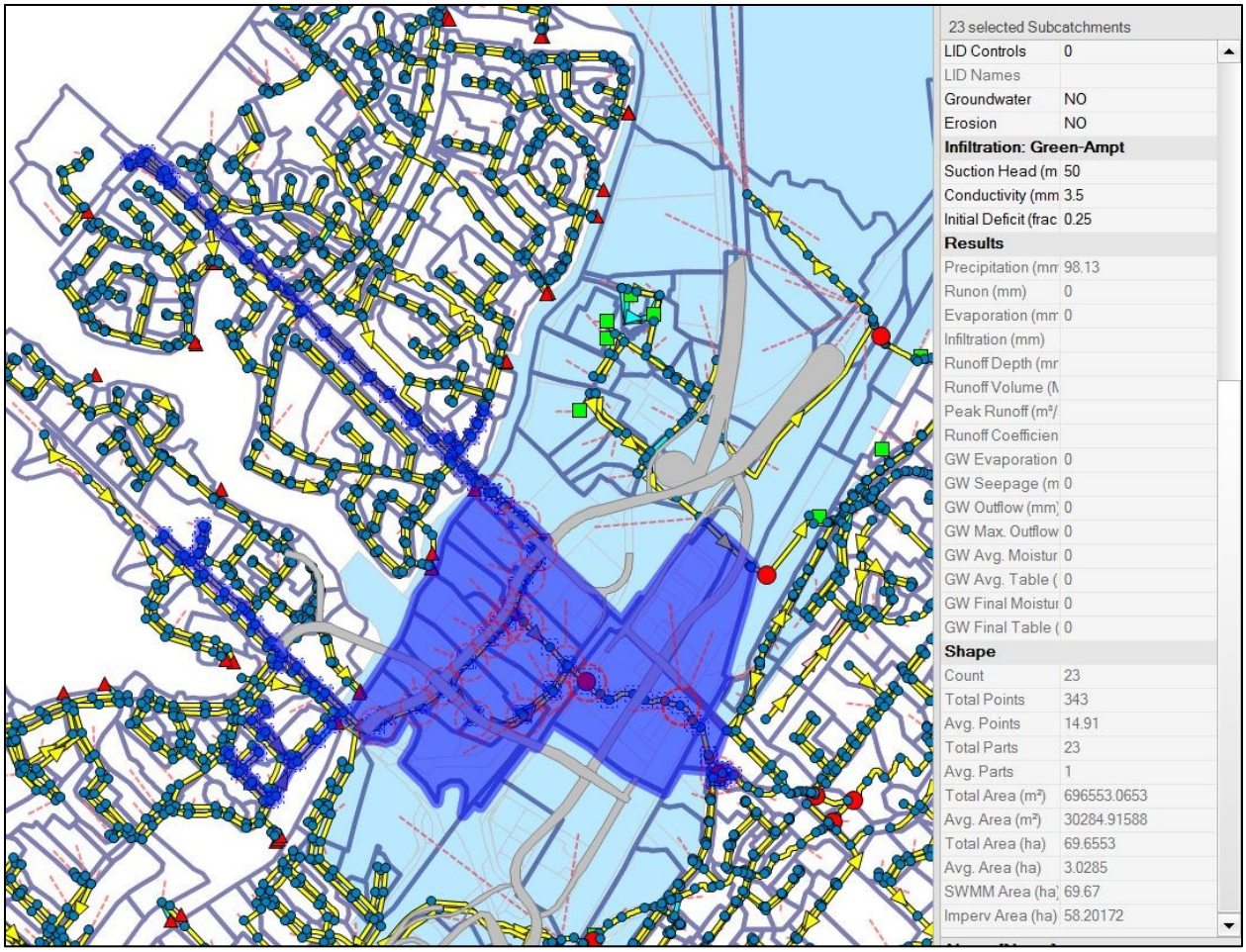


Image 3: Total Drainage area considered within Midtown for the Lower Morrison Creek – East Branch SWM facility.

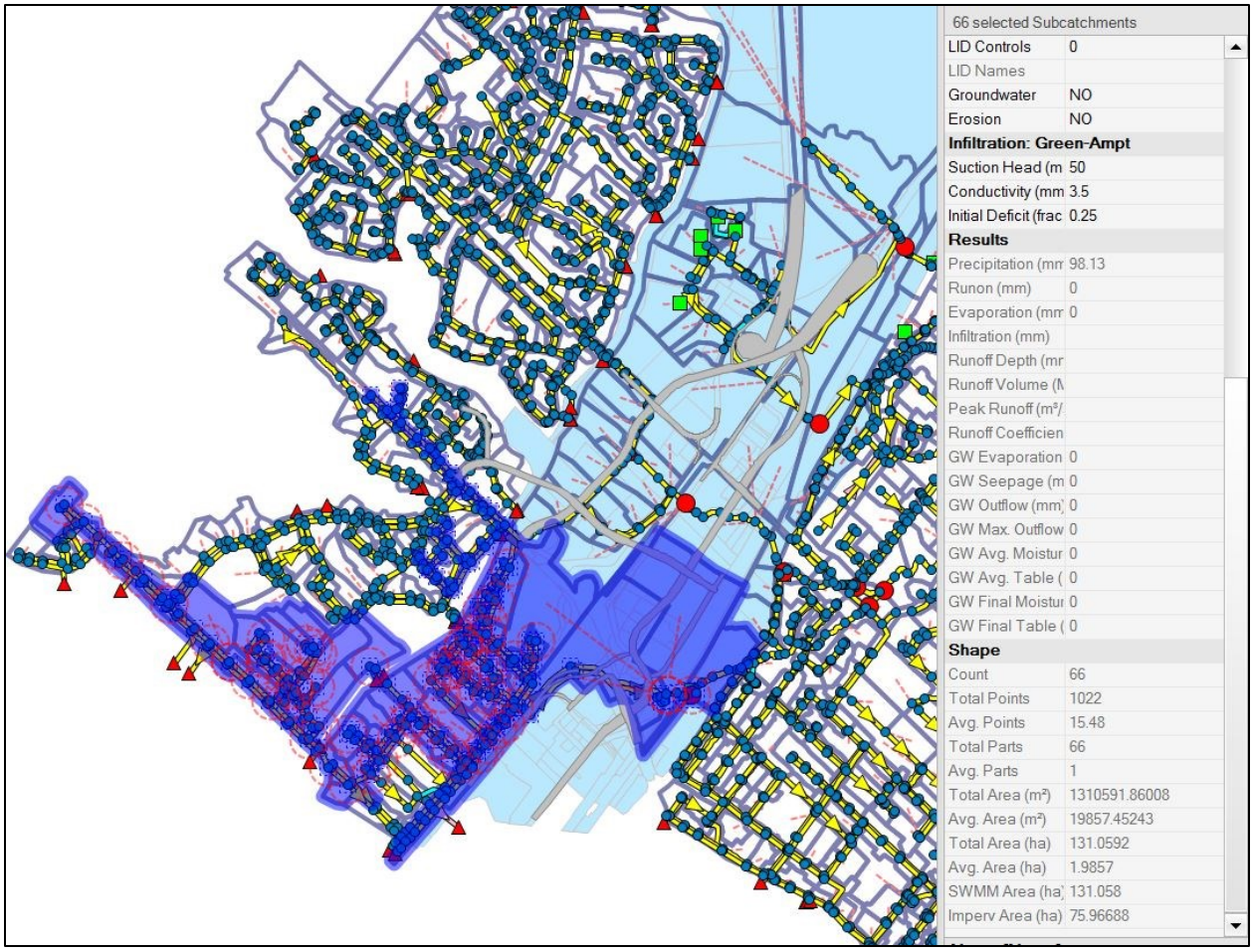


Image 4: Total Drainage area considered for the Lower Morrison Creek – West Branch. Due to Dual drainage network, it also includes drainage area upstream of Morrison-Wedgewood Diversion Channel.

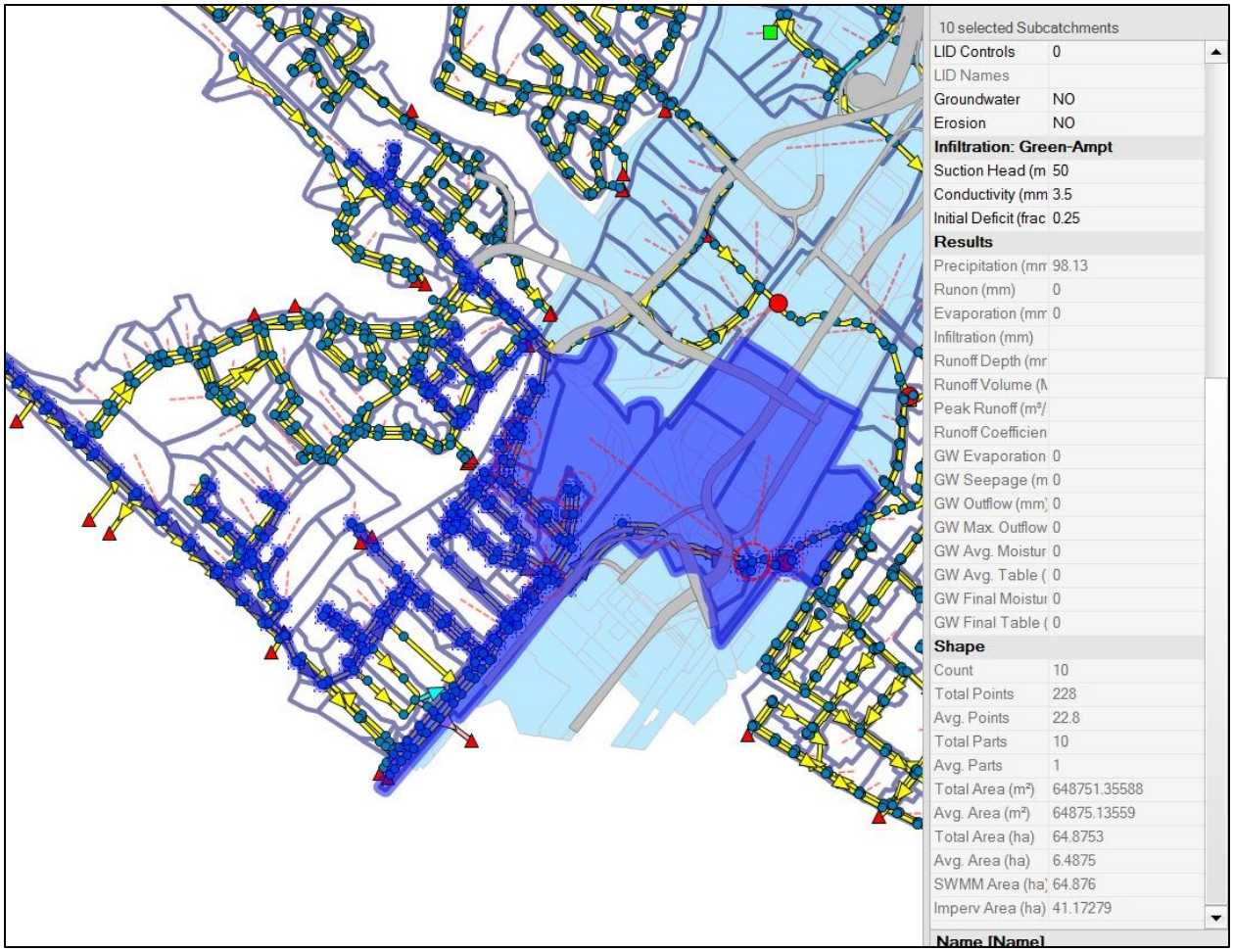


Image 5: Total Drainage area considered within Midtown for the Lower Morrison Creek – West Branch SWM facility.

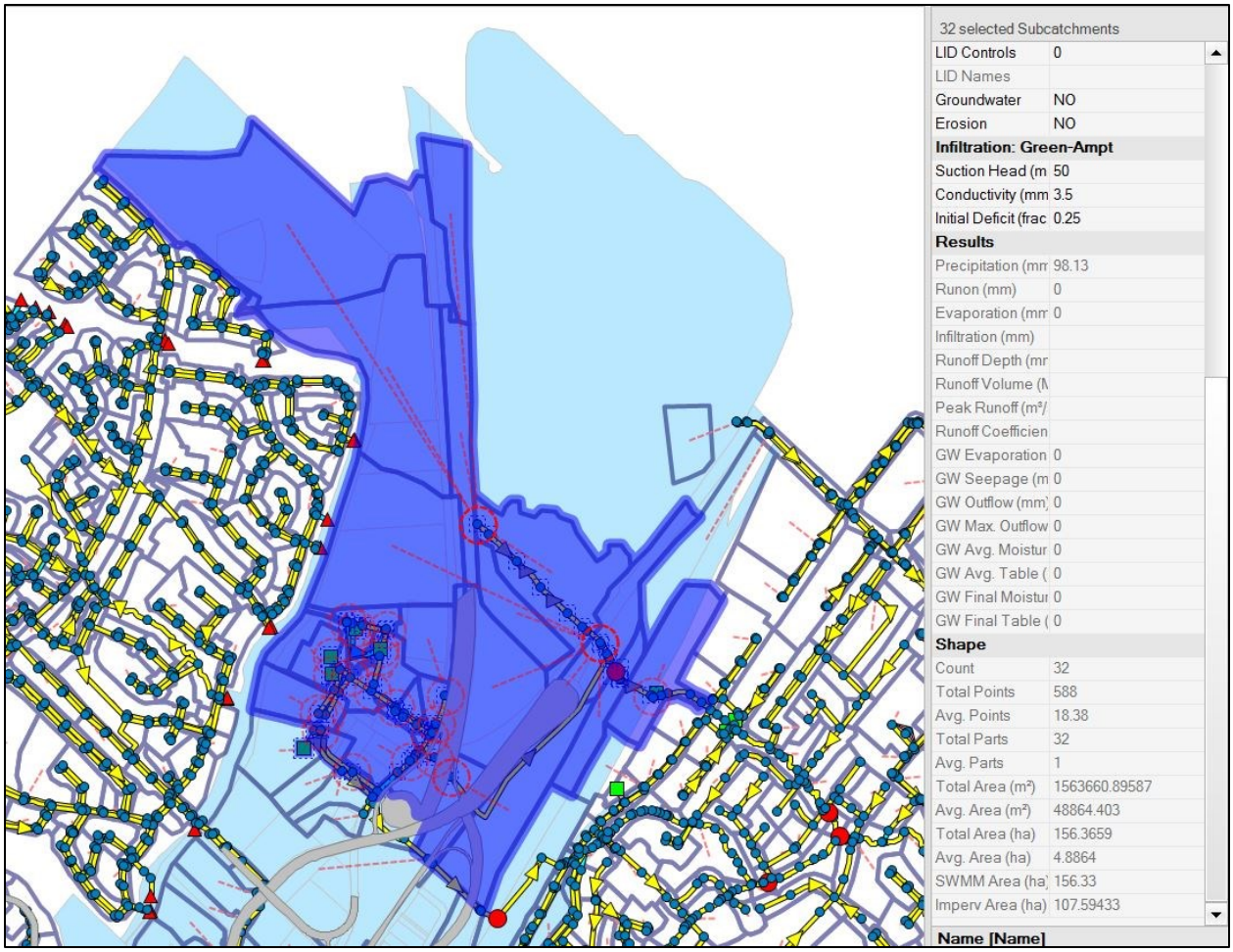


Image 6: Total Drainage area considered for the Lower Wedgewood Creek – East Branch SWM facility.

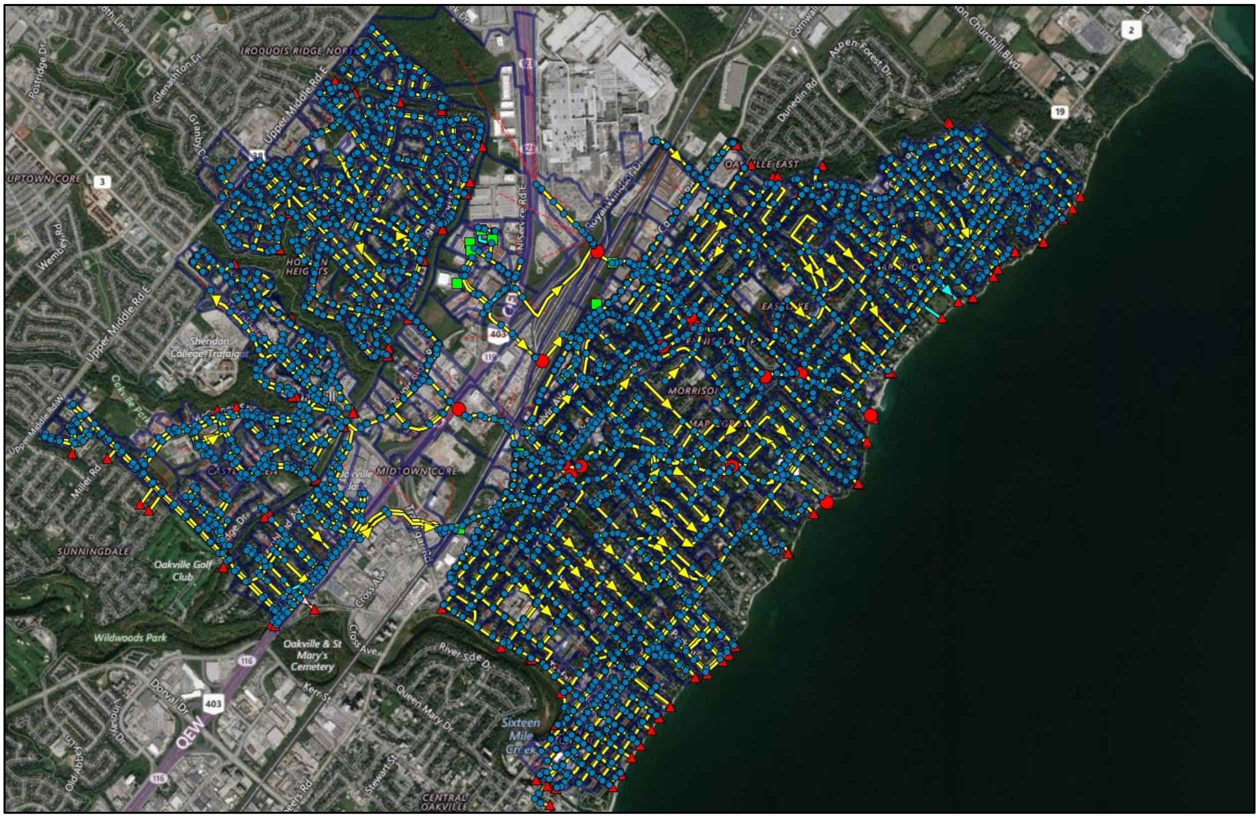


Image 7: Total Extent of the Lower Morrison Creek and Lower Wedgewood Creek PCSWMM model. See Attached drainage plan information to find out more about the locations of important nodes.

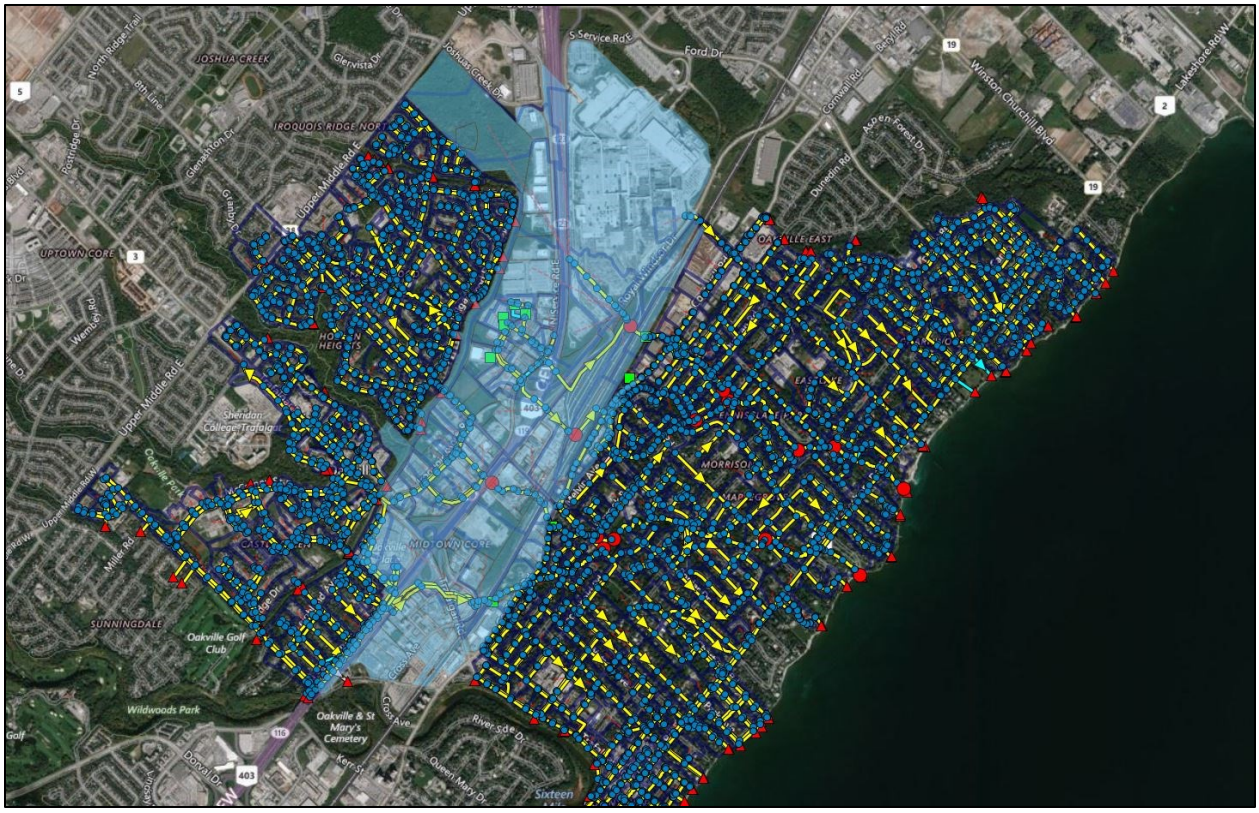


Image 8: Total Extent of the Lower Morrison Creek and Lower Wedgewood Creek PCSWMM model with proposed Midtown Development Area. See Attached background information (Ref. Appendix 'A') to find out more about it.

5. Is there Aboriginal knowledge or historically documented evidence of past Aboriginal use on or within 300 metres of the property (or property area)?

Check with:

- Aboriginal communities in your area
- local municipal staff

Other sources of local knowledge may include:

- property owner
- local heritage organizations and historical societies
- local museums
- municipal heritage committee
- published local histories

6. Is there a known burial site or cemetery on the property or adjacent to the property (or project area)?

For more information on known cemeteries and/or burial sites, see:

- Cemeteries Regulation Unit, Ontario Ministry of Consumer Services – for database of registered cemeteries
- Ontario Genealogical Society (OGS) – to locate records of Ontario cemeteries, both currently and no longer in existence; cairns, family plots and burial registers
- Canadian County Atlas Digital Project – to locate early cemeteries

In this context, 'adjacent' means 'contiguous', or as otherwise defined in a municipal official plan.

7. Has the property (or project area) been recognized for its cultural heritage value?

There is a strong chance there may be archaeological resources on your property (or immediate area) if it has been listed, designated or otherwise identified as being of cultural heritage value by:

- your municipality
- Ontario government
- Canadian government

This includes a property that is:

- designated under *Ontario Heritage Act* (the OHA), including:
  - individual designation (Part IV)
  - part of a heritage conservation district (Part V)
  - an archaeological site (Part VI)
- subject to:
  - an agreement, covenant or easement entered into under the OHA (Parts II or IV)
  - a notice of intention to designate (Part IV)
  - a heritage conservation district study area by-law (Part V) of the OHA
- listed on:
  - a municipal register or inventory of heritage properties
  - Ontario government's list of provincial heritage properties
  - Federal government's list of federal heritage buildings
- part of a:
  - National Historic Site
  - UNESCO World Heritage Site
- designated under:
  - *Heritage Railway Station Protection Act*
  - *Heritage Lighthouse Protection Act*
- subject of a municipal, provincial or federal commemorative or interpretive plaque.

To determine if your property or project area is covered by any of the above, see:

- Part A of the MTCS Criteria for Evaluating Potential for Built Heritage and Cultural Heritage Landscapes

2016 which indicated the potential for eight(8) SAR to inhabit the study area (Appendix B). The SAR identified included the following:

- Butternut (*Juglans cinerea*) (endangered),
- Bank Swallow (*Riparia riparia*) (threatened),
- Chimney Swift (*Chaetura pelagica*) (threatened)
- Red-headed Woodpecker (*Melanerpes erythrocephalus)* (special concern)
- Little Brown Myotis (*Myotis lucifugus*)(endangered)
- Northern Myotis (*Myotis septentrionalis*)(endangered)
- Redside Dace (*Clinostomus elongates*)(endangered)

Natural Heritage Areas Make a Map (NHA MaM)

The Natural Heritage Areas Make a Map (NHA MaM) is a web application that provides information on provincial parks, conservation reserves, and natural heritage features (i.e., Areas of Natural and Scientific Interest (ANSIs), wetlands, woodlands, natural heritage systems related to provincial policy plan areas, such as the Niagara Escarpment, Oak Ridges Moraine (ORM) and Greenbelt Plans.

The NHA MaM also provides Natural Heritage Information Center (NHIC) data, which is organized into 1 km^2 map squares and includes information on plant communities, wildlife concentration areas, natural areas, provincially tracked species, SoCC and SAR. The map squares that overlap the study area and that were reviewed in this report include: 17PJ0913, 17PJ0912, 17PJ0813, and 17PJ0713.

Land Information Ontario Geospatial Data

Land Information Ontario (LIO) data is maintained by the MNRF and provides key provincial geospatial data for Ontario. Shapefiles obtained from the LIO open datasets were obtained and used to showing the natural features within the study area. Key datasets that were review for the study area include policy plan areas, municipal land use designations, ANSIs, provincial parks and conservation areas, wetlands, woodlands, and watercourses.

1.1.2 Other Publicly Available Databases

In addition to the MNRF records, other publicly available data sources were reviewed, specifically for records related to SoCC and SAR that could occur within the study area. A list of data sources reviewed is provided in Table 1.1, below. All of the data sources, except for the Atlas of the Mammals of Ontario, are organized into 10 x 10 km^2 map squares and include records from online users (or citizen scientists) who submit their observations to be included in the database. The data is reviewed by the database owner prior to making it available to the public The information from each of the data sources (i.e., atlases) were reviewed for the map square that overlaps the study area (i.e., 17PJ01). An assessment of presence/absence and habitat suitability for SAR identified in the study area was completed.